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ANATOMY *1839.*

OF THE
Human Bones and Nerves:

WITH
An Account of the reciprocal
Motions of the HEART,

A N D
A Description of the HUMAN
LACTEAL SAC and DUCT.

By ALEXANDER MONRO, *Professor of*
Anatomy in the University of Edinburgh,
and F. R. S.

The THIRD EDITION, Corrected and Enlarged.

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ALPHABET

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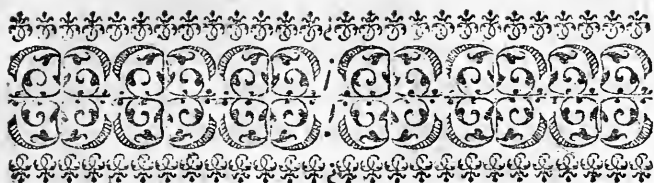
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T O T H E

Students of Anatomy

I N T H E

University of EDINBURGH;

GENTLEMEN,

*W*HEN I first engaged to publish an Osteology, I had no near View of your being favoured with Treatises on the same Subject by so many great Masters in Anatomy as have wrote since that Time. Had I known that Albinus, Winslow and Palsyn were to have published Descriptions of the human Bones, my Papers probably would have remained yet undelivered to the Printers: I however flatter myself, that this Essay has

a 3

been

been of Use to the Gentlemen who did me the Honour to attend my Colleges, by assisting them to understand my Sense and Representation of Things in this fundamental Part of Anatomy; and that it has possibly been of more Advantage to them than a more complete Work from an abler Hand, unless my Demonstrations had been in the Order and Method of such an Author.

This View of your Improvement, Gentlemen, is a prevailing Argument with me, to cause this Essay to be reprinted, and you cannot reasonably blame me if I likewise acknowledge a selfish Motive for it. In a new Edition an Author has an Opportunity of making his Works more correct, complete, and consequently acceptable to the Publick, who may perhaps be indulgent enough to think this little Treatise not altogether useless, since more Reasoning on the Structure and morbid Phenomena of Bones is to be found in it, than in the other Writers, who have confined themselves almost entirely to the descriptive or proper anatomical Part of the Osteology.

I have here kept to the Plan of the former Editions, by first considering, in the Order that seemed to me most natural and methodical, all the Particulars which I thought necessary to be known concerning
Bones

▼

Bones in general; and in the second Part, I have described the several Bones composing the Skeleton.

The full grown Bones are what I principally endeavour to describe, but I have added as much of the Osteogenea, as I think serviceable in the Practice of Physick and Surgery.

That little might be omitted of what was formerly done on this Subject, I have taken all the Assistance I could from Books, but have never asserted any anatomical Fact on their Authority without consulting the Life, from which all the Descriptions are made; and therefore the Quotations from such Books, serve only to do Justice to the Authors, who have remarked any Thing in the Structure of the Parts that was commonly omitted, and to initiate you in the History of Anatomy, which I once proposed to make complete, so far as related to this Subject; but not being able to procure several Books, and being sensible how many more may have never come to my Knowledge, I laid aside this Design, of Purpose omitted many I could have inserted, and in some Places changed an older Author for a later one, who has more fully or clearly described what I treated of. Beside Anatomists, I have also named several other Authors

thors to confirm my reasoning by practical Cases, of which it is not to be supposed my Experience could furnish a sufficient Variety. You'll readily observe, that I quote no Passages with a View to criticise or condemn them. This Precaution of giving no Offence, is very necessary in those who are sufficiently conscious of their being liable to lay themselves open to just Censure; and it prevents Occasions of useless Wrangling, in which generally both Parties are Losers, and the Publick has little Advantage.

In this Treatise, I always make use of the most common Name of each Part, and have put the synonymous Names to be met with in Books at the Foot of the Page, that the reading might be smoother, and you might consult them at your Leisure, to assist you in understanding different Authors.

The Descriptions and Reasoning are here blended, without which I always find younger Anatomists soon are disgusted with Authors; their Imaginations cannot follow a long Chain of Descriptions, especially when they are not taught at the same time the Uses the described Parts serve: Their Minds must have some Relaxation by a Mixture of Reasoning, which never misses to strike the Fancy agreeably, and raises a
strong

strong Desire to understand the Principles on which it depends.

The Phænomena of Diseases are all deduced in this Essay from the Structure of the Parts, by Way of Corollaries and Questions; which such an anatomical Work confined me to; and this Method has otherwise a good Effect: For when one meets with an useful Proposition, and is obliged to employ a little Thought to find out its Solution, the Impression it makes is deeper, and he acquires a Fondness of it, as being in Part his own Discovery. My Pupils have frequently assured me, they could with very small Reflexion, trace out the whole Reasoning from which my Conclusions were drawn; I hope their Successors will also think this an agreeable Manner of being instructed. Those Gentlemen who desired I would add the Lectures I pronounce in my Colleges as a Commentary upon the Text where the Diseases are mentioned, will, I persuade my self, excuse me for not complying with their Desire, when they consider the Design of this is to be a School-Book, and how great the Difference is between instructing Youth in private, and pretending to inform the Publick.

In this Edition, I have corrected the Mistakes and obscure Passages which I discovered—

covered in the former, and in some Places I have made the Descriptions more full and exact, aiming all I could to shun unnecessary Minuteness on the one Hand, and a blameable Inaccuracy on the other: Whether I have hit that just Medium, is what you and the Publick must now judge.

I am still of Opinion that Figures of the Bones would at any Rate have been unnecessary in a Book that is intended to be illustrated and explained by the Originals themselves, but would be much more so now when my ingenious Friend Mr. Cheselden has published such elegant Ones; and, if I am rightly informed, Doctors Trew and Douglas are soon to publish others.

The advantageous Opportunities you have in this Place of studying all the different Branches of Medicine under the proper Professors in the University, and of seeing the Practice of Pharmacy, Surgery and Physick, with our Surgeon-Apothecaries and in the Infirmary, which must soon be fit for accommodating a considerable Number of Patients and Students; these Opportunities, Gentlemen, which your Interest, and I hope, your Inclinations, lead you to improve, will probably prove a happy Means of your making a considerable Figure in your
 seve-

several Stations: Whatever Assistance is in my Power towards such a desirable Event, shall be given with the greatest Pleasure by,

Your humble Servant,

ALEX^r. MONRO.



Errors of the Press.

Page.	Line.	for	read.
10	33	is	are.
ibid.	34	scarcs	scarce.
25	3	Resistance	Resistance.
47	12	Property	Propriety.
68	12	Tex-	Texture.
71	2	fonnd	found.
80	11	Ethmoides	Ethmoides.
81	35	Noise	Nose.
85	1	sagittal	sagittal.
87	19	sphenodal	sphenoidal.
92	26	additamentm	additamentum.
93	2	tempokum	temporum.
94	23	inferio	inferior.
96	29	tympannm	tympanum.
103	28	tke	the.
115	9	Eustachinana	Eustachiana.
135	22	the the	the.
146	ult.	Letter ,	Letter v,
152	8	Carrilrges	Cartilages.
303	10	Astraguls	Astragalus.





T H E
A N A T O M Y
O F T H E
Human Bones.

P A R T I.

Of the Bones in general.

BEFORE we can understand the Structure of the Bones, we must be acquainted with the Texture of a Membrane, which is contiguous to most of them, and from its Office of covering them is called *Periosteum**.

A

At

* *Membrana circumossalis, omentum ossibus impositum.*

At first View, the *Periosteum* appears a simple Compact Substance; but when recent, and still more when macerated in tepid Water, it is divisible into Layers; as indeed much finer and more subtile Membranes are: Therefore this Circumstance would not be worth remarking, was it not that the innermost Layer of Fibres seems to be constant, uniform, and distinct from all the others of which the *Periosteum* is composed; for it is never wanting, and its Fibres being commonly in the same Direction with the bony Fibres under it, are for the most part parallel one to another.

Some Authors are at Pains to prove this internal Layer of the *Periosteum* to be derived from the *dura Mater*: For, say they, since the Membrane covering the Scull is plainly a Production or Continuation of the *dura Mater*, which passes out between the Sutures; and since there are Muscles on the Head, as well as in other Parts, which might furnish a *Periosteum*, 'tis needless to assign different Origins to Membranes which have the same Texture and Uses. Nay *Havers* (a) adds further, in proof of this Doctrine, (and his Observation generally is true,) that he can demonstrate the *Periosteum* to be continued from one Bone to another, by prosecuting and raising it from the Ligaments which cover the Articulations. The great Design of all this arguing is, to support a Hypothesis, which prevailed a considerable Time, of all Membranes being derived from one or other of the two that cover the

(a) Osteolog. nov. Disc. 1.

Of the Bones in general.

3

the Brain; otherwise it is to no Purpose to dispute, whether the *Periosteum* is a Production or Continuation of the *dura Mater*, or if it ought to be esteemed a distinct Membrane, so long as we rightly understand its Structure and Uses.

The other *Strata* or Layers, of which the *Periosteum* is composed, are all derived from the Muscles; and their Fibres have different Directions, according to the Courses of these Muscles. This may be plainly perceived, when one separates some of the exterior muscular Fibres that are inserted into the *Periosteum*; for they may be traced on this Membrane, till after losing their muscular Appearance, they are intimately blended with its other Fibres, and enter into its Composition: And in tearing a Piece of the *Periosteum* when dried, the Disposition of these Fibres may be discovered, by the Membrane's yielding more easily when pulled according to the Course of the adjacent muscular Fibres, than when an Attempt is made to tear it transversely. Since then the Bigness, Number and Disposition of the Muscles, in respect of different Bones, or of the several Parts of the same Bone, are various, the Thickness of this Membrane must also be different. Hence we observe the *Periosteum* thick and strong in one Part, and much thinner and weaker in another.

The external Surface of this Membrane, where Muscles are not inserted, is very smooth and equal, the cellular Membrane, by which it is loosely connected to the surrounding Parts, readily collapsing as soon as it is cut; but the Side of

Processes:

the *Periosteum* next to the Bone is rough and unequal, a great many Fibres being produced from it to enter into the Pits and Furrows of the Bones. These Processes are principally

composed of small Vessels, lodged in Vessels. an exceeding thin cellular Substance;

as plainly appears, when we separate the *Periosteum* from a Bone, after a successful

Injection of the Arteries: For Arteries. then innumerable Branches of Vessels

are to be seen every where on the Membrane*; and the Processes, which formerly

appeared in the Form of very small white Threads, are filled with the injected Liquor;

and after they are broken, their Orifices are seen like so many coloured Points on the Surface of the Bone.

The Veins corresponding to these Arteries are generally to be seen in Subjects that die with their Vessels full of

Blood, tho' such numerous Ramifications of them cannot be demonstrated as of the Arteries, the Veins being incapable of allowing an injected Liquor to pass from their Trunks into their minute Branches.

The great Sensibility with which practical Authors affirm the *Periosteum*

to be endued, is a sufficient Proof that it is well provided with Nerves, tho' they

are too small to be traced upon it; and therefore one cannot well determine, whether they

are sent along with the Arteries in the common Way, or are derived from the tendinous

Fibres

* *Ruyfch* Epistol. 5. Tab. 5. fig. 1. 2. Epist. 8. Tab. 9. Fig. 1. 6.

Fibres of the Muscles expanded on the *Periosteum*. Whichsoever of them it is, the racking Pain with which People are tortured, when labouring under the deep-seated kind of *Paronychia*, or under *Exostoses*, *Nodi*, *Tophi* and *Gummata* from a *Lues Venerea*, gives a dire Conviction of the Existence of such Nerves.

By the frequent Furrows and Pits of the Bones, the Surface of the *Periosteum*, which insinuates itself every where into them, is much enlarged; and therefore a greater Number of Vessels are more conveniently distributed to the Bones, and their Cohesion with this Membrane must be stronger.

Besides the Vessels which pass through the *Periosteum* to the Sub-Perforationstance of the Bones, there are others that perforate this Membrane, and are proper to the Marrow; of which more hereafter. And frequently the Muscles pierce through the *Periosteum* to their Insertion in the Bones.

The chief Uses of the *Periosteum* are:

1. To allow the Muscles, when they uses contract or are stretched, to slide easily; and thereby also to prevent the Bones and Muscles wasting each other, which must have happened, had not this smooth Membrane been interposed.
2. To keep in due Order, and to support the Vessels in their Passage to the Bones.
3. By being firmly braced on the Bones, to assist in setting Limits to their Increase, and to check their Overgrowth.
4. To strengthen the Conjunction of the Bones with their *Epiphyses*, Ligaments and Cartilages, which in young Creatures are easily separated when this Membrane is taken away.
5. To

afford a convenient Origin and Insertion to several Muscles which are fixed to this Membrane. And *Lastly*, As all other sensible Parts, to warn us when any Injury is offered to the Parts it covers, which, being insensible, might otherwise be destroyed without our Knowledge, or endeavouring to procure a Remedy.

When the cellular Substance connecting the *Periosteum* to the surrounding Parts is destroyed, these Parts are fixed to that Membrane, and lose the sliding Motion they had upon it; as we see daily in Issues, or any other tedious Suppurations near a Bone. When the Vessels which go from the *Periosteum* to the Bones are broke or eroded, a Collection of their Liquids is made between the Membrane and Bone, which produces a sordid Ulcer or rotten Bone. This often is the Case after Inflammations of the *Periosteum*, or after *Small Pox*, Spotted Fevers, and Fractures.

As soon as this Membrane is removed, we discover the Substance of the BONES, which are the hardest most solid Parts of the Body, and generally of a white Colour, (as all other Parts are, where large Vessels do not enter;) only in a living Creature they appear bluish, which is owing to the Blood in the small Vessels under their Surface. The less therefore and fewer the Vessels are, and the thicker and firmer the bony Surface covering the Vessels is, the Bones will appear whiter. Hence the Bones of Adults are whiter than those of Children, and in both Young and Old the white Colour of different Bones, or of the several Parts of the
same

same Bone, will always be in Proportion to their Vessels and Solidities; which Circumstances ought to be regarded by Surgeons, when they are to judge of the Condition of Bones laid bare.

The Bones are generally esteemed insensible, and justly enough too; tho' there are some few extraordinary Observations handed down, which, if accurately made, would seem to contradict this Opinion, or at least to prove that the Bones, under some certain Circumstances, may become sensible. Witness the Case related by *Nicolaus Massa (a)*, of a fordid Ulcer of the Bone of the Leg, that was attended with most violent Pain on the least Touch of the Bone with a rough Instrument, tho' the *Periosteum* was all separated; nor could the Patient bear the Application of any such Instrument after the Bone was perforated.

The Bones are composed of a great many *Laminae* or *Plates**, which are *Plates* made up of Fibres or Strings laid in a convenient Order and Number, and united by smaller Fibrils, or *Appendiculæ filamentosæ* of *Malpighius (b)*; which being irregularly disposed, and interwoven with the other larger Fibres, make a reticular Work.

That the *Plates* of the Bones are composed of such Fibres, seems at least probable from the Analogy of the Substances that resemble Bones most; such as, Whalebone, or Horns, in which this fibrous Texture is evident. Then a strong Presumption of such a
Tex-

(a) Lib. Introduct. Anat. cap. 30.

* Squamæ, Bractæ.

(b) Anat. Plant, & oper. posthum.

Texture may be inferred, upon observing that Chinks made in Bones long exposed to the Weather, or calcined in the Fire, are generally disposed in the Direction which the longitudinal Fibres are found to have. Perhaps nice accurate Observations of the different Times that a Bone laid bare, and the Extremity of an amputated Bone, would take to exfoliate, might bid fair to determine the proportional Force of Cohesion which the Particles of the longitudinal Fibres have one to another, in respect of that Power by which the Fibres are connected to each other; or in other Words, the Strength of the longitudinal Fibres compared to the transverse. But to put this Structure of the Bones past Dispute, let us examine a *Fœtus*, in which the Bones are but a little advanced, and we shall distinctly see these bony Fibres, and can separate the Plates. Nay even in old Bones, after they have been any considerable Time exposed to Sun and Rain, whereby their Texture becomes more unravelled, or when they have been tortured by the Fire, and in some morbid Cases, we can divide the firmest Bones into *Plates*, and can observe the Fibres of each.

These Plates are said by *Gagli-claviculi. ardi* (a) to be firmly conjoined, by the Means of an infinite Number of *Claviculi*, or small bony Processes, which rising from the interior *Lamellæ*, pierce thro' some, and are fixed into others of the more external Plates. Of these bony Nails, he has described and painted four different Species, which,

(a) Anat. ossium nov. invent. illustrat. cap. 1. Obs. 2.

which, he affirms, are most conspicuous in the Bones of the Head, after they have been so prepared by long boiling, burning, or exposing to the open Air, that their Plates will separate with little Violence. The *Claviculi*, which rise up streight, and terminate in a small Point, he calls *perpendicular*. *Perpendicular.* If such *convoid* Nails rise slanting, *Oblique.* he names them *oblique*. If the *Clavicles* stand perpendicular, but become larger at their Extremities, he styles them *capitati* or *headed*. *Headed.* If they appear oblique but crooked towards their Point, the Name he gives them, is *ad angulum retorti* or *crooked*. *Crooked.*

After the *Claviculi* are thus classed with distinguishing Names, *Gagliardi* (a) endeavours to shew how they are differently formed, and mentions some analogous Experiments he made to illustrate his Theory; concluding the Account of them with his Reasons for this Mechanism of the Bones serving better than any other, the Design of keeping the Plates firmly united; and obviating a Difficulty might be proposed, of an Inconvenience happening from those Nails which pierce the most external Plate hurting the *Periosteum* and even the Muscles, when pressed strongly against the Bones; for all this, he says, is prevented, because the *Claviculi* never rise above the Surface of the Bones.

This History of the *Claviculi* may perhaps be true, but it is more than I can vouch: For tho' after separating the *Laminae* of some Bones,
duly

(a) Anat. ossium nov, invent, illust. cap. 1. Obs. 2,

duly prepared, I could, with the help of a Microscope, easily see a great Number of Inequalities or little Processes rising out from the Plates, yet I could never discover these Figures, Shapes or Situations which *Gagliardi* assigns them; nor do I know any other Anatomist who pretends to have seen or to demonstrate such bony Nails as I have described from that Author. No less an accurate Discoverer of the minute Structure of Animals than *Malpighius* (a), thinks these nothing else, than some few of the bony Fibres rising perpendicularly, while the greatest Number run horizontally, and denies them to have any such regular Appearance.

The Sides of the Bones are composed of Plates thus firmly united by the small Processes, but their internal Substance is more spongy and cellular, the bony Fibres forming here the *Cancelli* or Lattice-work in the following Manner. All the Plates are firmly conjoined about the middle of the Bone; but as they are extended towards its Extremities, the more internal Plates separate from the exterior, and stretch out their Fibres towards the Axis of the Bone, where they are interwoven with the Fibres of others that have been sent off in the same Way; and seeing the Plates are thus constantly going off in their Course towards the Extremities; the solid Sides of the Bone must become thinner proportionally, and the Lattice-work must be thicker and stronger. This is very remarkable in some Bones, where the solid Sides of their middle is half an Inch thick, and the *Cancelli* are scarce
observe

(a) Oper. posthum.

observable, whereas at their Extremities, where their Diameter is greatest, the solid Walls or Sides are not thicker than Paper, and the *Cancelli* are numerous and large enough to fill up the whole Space left between the Sides.

Gagliardi (a) minutely remarks the different Appearances of these *Laminae*, after they begin to separate from the more external Plates to form this Lattice-work, and according to these Appearances, has imposed different Names on them. As for Instance, when they make the first Turn or Wrinkle, he styles them *Cancelli corrugati*, which he divides into two Sorts, from their being more or less wrinkled. The next Species is called *Perforati* or *Cribriformes*, because the Fibres of the Plates separating more, leave small Holes in their Interstices: This Sort is also subdivided. When the Fibres come to be so divided and interwoven as to form a Network, they obtain the Name of *Reticulares*; these are again distinguished by an Epithet of *majus* and *minus*. The Twisting and Windings which these *Cancelli* make, and the Interstices which they leave, differ considerably in Figure, Number and Magnitude, and therefore form little Cells, which are as different, but communicate with each other, some by one, others by two or three Pores.

This cellular Texture is so universal as to take Place through the whole interior Part of the large round Bones, such as the Thigh or Arm-

(a) Anat. ossium. cap. 1. Obs. 4. 5. 6. 7.

Arm-Bone. For tho' Authors, in the Description of these Bones, only take Notice of this Structure near their Extremities, and mention an uninterrupted Cavity in their middle; yet if they are carefully kept without tumbling and tossing about, till their Marrow is exhausted; or if they are calcined with the like Care, and then Part of the Bone is cautiously separated, the reticular *Cancelli* may be observed, of a beautiful curious Texture, through the whole Extent of the Bone, especially in the middle, where this Cavity is commonly said to be seen, but composed of such fine delicate Fibrils in this Place, as to be easily destroyed in preparing, without some Precaution and Care, which I imagine is the Reason why they have been so generally neglected in the Descriptions of Bones.

The *Cancelli* sustain the membranous *ves.* Bags of the Marrow which are stretched upon them, and thereby hinder these membranous Parts to be torn or removed out of their proper Places in the violent Motions and different Positions which the Bones are employed in, or in the several Degrees of Distension which the Bags are brought to, by the Marrow contained in them, being increased or diminished in its Quantity. By this Support which the *Cancelli* afford the Marrow, we may also see how the Membranes and Vessels of this Substance, in the lower Extremities of the Bones, are saved from being compressed by the Weight of the Marrow in the middle and superior Extremities, which would make a considerable Pressure in the long perpendicular Bones.

Besides the Pits and Furrows on the external Surface of the Bones, which I mentioned when the *Periosteum* and the Passages of the medullary Vessels were described, there are Pores passing outwards from the more external *Cancelli*, directly cross the Bone, which open into other Canals, that are disposed longitudinally; from which again, other transverse Passages go out to terminate in other longitudinal Canals, and this Structure is continued all through the solid Substance of the Bone. Both these Sorts of Canals are numerous and large near the Lattice-work, but gradually decrease towards the external Surface of the Bones, as may be seen distinctly with a Microscope, or even with the naked Eye, in a Bone burnt till it is white. 'Tis true indeed, we may, by viewing a burnt Bone, be imposed on to believe both Sorts of these Canals more numerous than they really are, because, as *Morgagni (a)* has remarked, the Holes made by the transverse Processes connecting the Plates of the Bones, will have the Appearance of transverse Pores; and the Canals in which the Blood-vessels are contained, resemble the longitudinal. These two Sorts of longitudinal Canals may, in my Opinion, be distinguished from each other by the following Marks: The Passages for the Vessels are largest near the external Surface of the Bones, and every transverse Section of them is circular; whereas the longitudinal Canals a-

Passages for
the Marrow.

Transverse.

Longitudi-
nal.

B

bove

(a) Advers. 2, animad. 25.

bove described, are, as was already said, largest where they are nearest the Cavity of the Bone, and their transverse Sections appear to me of a flat oval Figure; which Difference may be accounted for, by considering the Pressure which all Canals situated between the Plates of Bones must suffer, and the great Disproportion between the Forces by which the Fluids contained in these two Kinds of Canals are propelled.

In the larger Sort of both transverse and longitudinal Canals, nearest to the *Cancelli* of a recent Subject, we see Marrow contained, hence we have Reason to conclude, that it passes also into the smaller ones. This will appear more probable, upon seeing with a Microscope, Drops of Oil every where on the Surface of fresh Bones broke transversely, and after observing that the Marrow makes its Way through the most solid Bones, even in a dead Body, as is evident it does, from the Greasiness and yellow Colour, which Skeletons, tho' ever so clean and white at first, contract in a little time. Of what Advantage this Distribution of the Marrow through the bony Substance is, shall be considered, after that Animal Oil is examined.

The Arteries derived from the *Periosteum*, formerly described, are distributed through the whole Substance of the Bones, as is evident after a successful Injection; and in sawing, rasping or cutting the Bones of living Creatures, these Vessels plainly discover themselves by the small Drops of Blood which ouze out. The Blood-vessels are larger near each Extremity than at the

the middle of the large Bones that are much moved, because near the Extremities, they not only serve the Bones, but pass through them to the Marrow. These Vessels of the Bones sometimes become very conspicuous, if Observators have not mistaken: A remarkable enough Instance of this, is *Diemerbroek's* (a) Observation of an Artery in the anterior middle Part of a carious *Tibia*, whose Pulsation he saw evidently for many Days; and *Mery* (b) demonstrated to the Royal Society at *Paris*, a large Artery piercing cross a sound hard Bone.

Veins no doubt there are, which return the Blood from the Arteries of the Bones, and probably discharge themselves into the Veins of the *Periosteum*. Veins.

The great Sensibility of the granulated red Flesh, that sprouts out from Bones, after applying a Trepan, or after an Exfoliation; and *Massa's* Observation of a painful Ulcer of a Bone already related, make a Probability of Bones being supplied with Nerves, tho' we cannot trace them by Dissection. Nerves. Nor is this contradictory to what was formerly said, of the Bones being insensible in their natural State, if we consider, that tho' the Nerves do for ordinary communicate Sensibility to all the Parts they serve, yet when they are cut, or are too much compressed, or when the Part they are sent to is too rigid to allow Objects to affect them, they produce no such Effect, which last, is the precise Case of Bones as long as they are firm and
B 2
found.

(a) Anat. lib. 2. cap. 1.

(b) Hist de l'Acad. de Sciences, 1704.

found. When these Circumstances are rightly weighed, we may, I say, be less surprized at the seeming Contradiction of the following Assertion, that an unmortified Part of a living Creature can have Nerves distributed to it, and yet enjoy no Sensation. Of this we have another Example in Parts very analogous to Bones, the Nails.

Since Bones are plentifully supplied with these different Sorts of Vessels, it is plain that there is a constant Circulation of Fluids in every Part of them, and that there must be a perpetual Waste and Renewal of the Particles that compose the solid Fibres of Bones, as well as in the other Parts of the Body; the Addition from the Fluids exceeding the Waste during the Growth of the Bones, the Renewal and Waste keeping pretty near *par* in adult middle Age, and the Waste exceeding the Supply from the Liquors in old Age, as is evident from their Weight. Each Bone becomes heavier as a Person approaches to Maturity, continues near the same till old Age comes on, and then turns lighter. The specific Gravity of equal Parts of their solid Sides observing the reverse Rule, that is, by Age the solid Parts of Bones become more hard, compact and dense.

From the intimate Distribution of *Diseases.* the Vessels thro' the Substance of the Bones, we can judge how these Parts may be affected with *Obstructions*, *Ecchymoses*, *Ulcers*, &c. from an internal or external Cause, as well as the softer Parts of the Body; and how the Erosion of the bony Substance by these Diseases might occasion such a cellular
Appear-

Appearance, as *Knyfch* (a) describes, in the most solid Part of a Bone, without giving us any Reason to expect such natural *Cancelli* in found Bones; or how when the Sides of these morbid Cells are destroyed, the exterior Part of the Bone may be found as a Tube, including the interior Bone, which *Knyfch* (b) also observed. The Reason of a common tho' unheaded Phænomenon of carious Bones, to wit, a regular alternate Elevation and subsiding, or an apparent Pulsation of the *Pus* contained in some of the eroded Cells of the Bone, may likewise be hence understood.

The Bones, in the same Manner as the other Parts of Animals, when exposed to a strong Fire in proper Chemical Vessels, are resolved into *Chemical Analysis* *Phlegm*, *Spirit*, *volatile Salt*, *fetid Oil*, and a black *Caput mortuum*, which last calcin'd in an open Fire, has its more fixed Oil, to which the black Colour was owing, forced away, and a white Earth is left that has no Mixture of fixed Salt in it; on which Account, these Ashes are the most proper Materials for forming into Vessels, that are to undergo the greatest Force of Fire, being scarce capable of ever vitrifying, which other Substances are very liable to. This Earth would seem to be the proper constituent solid Part of Bones; for the Quantity of it is great; greater, says *Havers* (c), than of all the other Principles taken together; and after all the others are separated from a Bone, its former Shape still remains,

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(a) Thesaur. 8. N^o. 8. & Thes. 10. N^o. 176.

(b) Thesaur. 10. N^o. 176.

(c) Osteolog. nov. Disc. 1.

tho' it becomes so brittle as to moulder into Dust on the least Touch; and when moistned with a little Water or Oil, it recovers some Degree of Tenacity, but can never be restored to its former Firmness; since it is not possible by any Art to reduce Bones to their natural State, once they are changed, and have their several Principles separated by a chemical *Analysis*.

Seeing therefore the Solidities of Bones increase by Age, and the Proportion of Earth to the other Principles, becomes greater, while some of these degenerate from their former State, we may see one Reason why the Bones of old People are more brittle than those of young.

The Bones serve to sustain, and defend
uses. the other softer, less firm, and less solid Parts.

The Bones are lined within, as
 PERIOSTEUM well as covered externally, with
 INTERNUM. a fine Membrane, which is therefore commonly called *Periosteum internum*.

This *Periosteum* is an extremely fine Membrane, nay in several Bones it has a loose reticular Texture, and therefore it is compared by some to the *Arachnoid* Coat of the spinal Marrow; so that we cannot expect to divide it into Layers, as we can divide the *external Periosteum*. We can however observe its Processes entering into the transverse Pores of the Bones, where they probably are continued to form the immediate Canals for the Marrow distributed through the Substance of the Bones.

Pro-

Probably too *Winslow* (a) may be right in thinking, that along with these Processes of this Membrane, Vessels are sent, as from the external *Periosteum*, into the Bone; but I could never make an Injection enter these Vessels, nor could I see them any other Way. These Processes being of a very delicate Texture, the Adhesion of this Membrane to the Bone is small, so that it separates commonly more easily from the Bone than from the Marrow it contains; wherefore one might call it the common Membrane of the Marrow, rather than the Name it now has. But whether one or t'other Designation ought to be given it, is not worthy a Dispute.

From the internal Surface of the internal *Periosteum*, a great Num- MARROW.
ber of thin Membranes are produced, which passing a-cross the Cavity, unite with others of the same Kind, and form so many distinct Bags, which communicate with each other; and these again are subdivided into communicating vesicular Cells, in which the Marrow is contained. Hence it is, that the Marrow, when hardned and viewed with a Microscope, appears like a Cluster of small Pearl; and that the hardned Marrow of Bones buried several Years under Ground, and examined by *Ruyfch* (b), is granulous, or composed of very small Grains, as I have likewise frequently seen it in Bones laid sometime in Water, and then exposed to the Air to dry. This Texture is much the same with what obtains in the other cellular

(a) Exposition anat. des Os frais, § 82. 83.

(b) Thesaur. 9. N^o. 2. & Advers. Dec. 111, Obs. 9.

cellular Parts of the Body, where Fat is collected, only that the Cells containing the Marrow are smaller than those of the *Tunica adiposa* or *cellulosa* elsewhere. The Marrow is nothing then but the more oily Part of the Blood, separate by small Arteries and deposited into these Cells: Any red Colour it seems to have in some Parts, is owing to the Blood-vessels on the cells containing it being larger and more numerous at these Places.

Besides the Arteries which I mentioned already, *p.* 15, to be sent from the Bones to the Marrow, there is at least one Artery for each Bone, several Bones have more, whose principal Use is to convey and secern this oily Matter. After these Arteries have pierced the solid Side of a Bone, they are divided into several Branches, which soon are distributed every where on the internal *Periosteum*, and afterwards spread their Branches on the medullary Cells.

The Blood, which remains after the *Veins.* Secretion of the Marrow, is returned by proper Veins, which are collected from the Membranes into one or two large Trunks, to pass out at the same slanting oblique Hole or Passages at which the Artery or Arteries entered.

We can trace the Nerves a good *Nerves.* Way in their Division on the Membrane of the Marrow along with the Blood Vessels, but their minute Ramifications proper to the particular Cells are too small for us to dissect. By the Experiments however of *Du Verney (a)* on Men and Brutes, which I have

(a) Memoires de l' Acad. des Sciences, 1790.

have likewise made, the Sensibility of these Membranes, and consequently their being supplied with nervous Filaments is sufficiently proved; the racking Pain with which Suppurations within Bones are frequently attended, gives a woful Conviction-how sensible these Membranes are; so that *Hippocrates* (a) might say very reasonably and justly, that a Wound penetrating into the Cavity of a Bone would produce a *Delirium*.

The Arteries, Veins, and Nerves of the Marrow, wrapt up in one common Coat, from the *Periosteum*, pass thro' the Bones by proper Channels, the most considerable of which are about the Middle of each Bone, and are, especially in the human Body, very oblique: Sometimes these Vessels continue at a little Distance in their Passage, when the bony Canal is divided by a small bony Partition or two. Passage.

The Marrow is of very considerable Use to the Bones; for by entering the transverse Pores already described, and passing from them into the longitudinal ones, it is communicated to all the Plates, to soften and preserve them from turning too brittle; and consequently the Bones are kept stronger to resist Injuries. This Distribution is thus made more equally, and without weakening the Bones so much as a sufficient Number of transverse Pores alone must have done. How far this Oil contributes to the Firmness of the Bones, is sufficiently demonstrated by observing their Brittleness, when it is consumed, or loses

(a) Aphorism. sect. 7. Aph. 24.

loses its oily Consistence, as in scorbutick, pocky Patients, in old People, or in such Bones as have been deprived of this Oil by Fire or Weather.

Besides this Advantage which the Substance of the Bones has from the Marrow, their Articulations receive no less Benefit; for there are several Holes near the large Joints, which communicate with the medullary Cells, and transmit the Oil to the Articulations, as is plain from the Marrow found often congealed in these Pores of fatted Beasts. In this Way then, all the Parts concerned in the Motion of the Joint will be lubricated; and when the Mucilage secreted here, and to be afterwards described, is incorporated with the Oil, one of the most effectual Mixtures is formed for such an Use. The Quantity of this Liquor supplied to the Articulations, is always in Proportion to the Quantity of Motion performed by the Joints; and hence by Exercise or Labour, the Quantity of Marrow is diminished; so that Butchers can tell, by looking at the Bones of slaughter'd Cows, whether they have lately come off a Journey, or have been fed some Time in Parks in the Neighbourhood.

When the Marrow, after having served the Uses mentioned, is reassumed into the Mass of Blood, (as it is continually, in common with all the other secreted Liquors that have not Passages formed for conveying them out of the Body,) it corrects the too great Acrimony communicated to the Saline Particles of our Fluids, by their Circulation and Heat; in the same Manner as the Lixivial Salts are blunted by Oil in making Soap. Hence in acute Diseases,

eases, the Marrow, as well as the other Fat of the Body, is quickly wasted.

As the Nature of all Oil is to become thin and rancid when exposed long to Heat, we may thence, and from the Structure of the Bones, see the Necessity of that ungrateful Smell and black thin *Ichor*, which proceeds from corrupted Bones, rather than from any other Part of the Body; and can understand the Reason of the Changes of Colour which Bones undergo, according to their different Degrees of Mortification. Hence likewise we may learn the Cause of a *Spina ventosa*, and of the Difficulty of curing such *Caries* of Bones as proceed from an Obstruction, and consequent Putrefaction of the Marrow; and of a quick Pulse, Thirst and *hectic Paroxysms*, so often attending these Diseases in the Bones. And from these *Phænomena* we may deduce the Reason of the mortal *Prognosis* taken from black fetid Urine in Fevers.

Tho' the Bones so far agree in their Structure and annexed Parts, yet we may observe a considerable Difference among them in their Magnitude, Figure, Situation, Substance, Connexion, Uses, &c. From which Authors have taken Occasion to distinguish them into as many Classes as they could enumerate of these different Circumstances. But these being so obvious to every Person that looks on Bones, I shall content my self with mentioning only one of them; which tho' at first Sight very remarkable, yet comprehends very near the whole Bones of the Body, and at the same Time

Bones distinguished.

Time leads us to examine the most considerable Variety that is to be found in the Disposition of their constituent Parts, and in their Uses. It is this, That some Bones are broad and flat, while others are long and round.

The *broad* Bones have thin Sides, by
Broad. the Plates being soon and equally sent off to form the *Cancelli*; and this Lattice-work is thicker, and near of an equal Form all through. By this Structure they are well adapted to their Uses, of affording a large enough Surface for the Muscles to rise from, and move upon, and of defending sufficiently the Parts they inclose.

The *round* Bones have thick strong
Round. Walls in the Middle, and become very thin towards their Extremities; which is owing to very few Plates separating at their Middle, where on that account the *Cancelli* are so fine and small that they are not taken notice of: But such Bones are said to have a large Reservoir of Oil in this Place. Towards their Extremities the Lattice-work becomes very thick, and rather more complete than in the other Sort of Bones. These round Bones having strong Forces naturally applied to them, and being otherwise exposed to violent Injuries, have need of a cylindrical Figure to resist external Pressure, and of a considerable Quantity of Oil to preserve them from becoming too brittle. Besides which they are advantageously provided with thick Sides towards their Middle, where the greatest Forces are applied to injure them; while their Hollowness increases their Diameter, and consequently their Strength to resist Forces
 ap-

applied to break them transversely, as has been demonstrated by *Galileus* (a). Thus, for Instance, in estimating the proportional Resistance of two cylindrical Bones of unequal Diameters, but consisting of an equal Number of similar Fibres uniformly disposed round each, it is plain:

1. That the absolute Force of these two Bones is equal, because they consist of equal Number of similar Fibres.

2. That the absolute Forces of all the Fibres in each Bone will have the same Effect, in resisting any Power applied to break them, as if the Sum of all their Forces was united in the respective Centers of the transverse Sections where the Fractures are to be made. For by Hypothesis the Fibres being uniformly disposed in each, there is not any Fibre in either Bone that has not a corresponding Fibre, the Sum of both whose Distances from the Axis of Revolution (about which all the Parts of the Bone must revolve in breaking) is equal to two Semidiameters of the Bone; Consequently each Fibre, and all the Fibres, may be regarded as resisting at the Distance of one Semidiameter or *Radius* from this Axis, that is, in the Center.

3. Since the united Force of all the Fibres is to be regarded as resisting at a Distance from the Center of Motion equal to the Semidiameter, it follows that the total Resistance of all these Fibres, or the Strength of the Bone will be proportional to its Semidiameter, and consequently to its Diameter.

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(a) Mechanic. Dialog. 2.

I have here taken for an Example one of the most simple Cases for calculating the proportional Force of Bones; but was it not too foreign to the present Design, it might be universally demonstrated, that of whatever Figure Bones are, and in whatever Manner their Fibres are disposed, their Strength must always be in a *Ratio*, compounded of the Area of their transverse Sections, or of their Quantity of bony Matter, and of the Distance of the Center of Gravity of these Sections from the Center of Motion, or Fulcrum, on which the Bone is supposed to be broken *.

Since therefore the Strength of Bones depends on their Number of Fibres or Quantity of Matter, and the Largeness of their Diameters, one may conclude, that the Part of a Bone formerly fractured, and reunited by a *Callus*, must be stronger than it was before the Fracture happened; because both these Advantages are obtained by a *Callus*: Which is a wise Provision, since Bones are never set in such a good Direction as they were naturally of; and then wherever a *Callus* is formed, there is such an Obstruction of the Vessels, that if the Bone was again broke in the same Place, the *ossifick* Matter could not so easily be conveyed to reunite it. This *Callus* may indeed, for want of Compression, be allowed to form into a spongy cellular Substance, as *Ruyfch* (a) says he has sometimes seen it; but even in this Case the Strength of the Bone at this

* See the Demonstration of this Theorem by Dr. *Porterfield* in the *Edinburgh Medical Essays*, Vol. 1. Art. 10.

(a) *Theaur.* 8. n. 49. & *Mus. Anat. Theor.* B. *Reposit.* 2. n. 2.

this Part would be still increased by one or both the Causes above mentioned.

Many Bones have Protuberances or *Processes* * rising out from them. If *Processes* a *Process* stands out in a roundish Ball, 'tis called *Caput* or *Head*. If the Head is flattened, it obtains the Appellation of *Condyle*. A rough unequal Protuberance is called *Tuberosity*. When a *Process* rises narrow, and then becomes large, the narrow or small Part is called *Cervix* or *Neck*. Such *Processes* as terminate in a sharp Point, have the general Name of *Coronæ* † or *coronoid* bestowed on them, tho' for the most Part they receive particular Names from the Resemblance they have, or were imagined to have to other Substances, e. g. *Mastoid*, *Styloid*, *Anchoroid*, *Coracoid*, *Spinal*, &c. Such *Processes* as form Brims of Cavities are called *Supercilia* *.

Processes serve for the advantageous Origine and Insertion of Muscles, and *Uses* render the Articulations firmer and more stable.

Before leaving this Subject we must remark, that much the greater Number of what are called *Processes* in adult Bones, discover themselves in Children to be *Epiphyses* or distinct Bones, to be affixed afterwards; as the *Mastoid* and *Styloid* *Processes* of the temporal Bones, *Processes* of the *Vertebrae*, *Trochanters* of the Thigh, &c. However, as I design to insist chiefly

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* Ἀπόφυσεις, ἔκφυσεις, ἐξοχή, προβολή, πρόσλημα, Excessus, Explantatio, Tuberculum, Gibbus, Eminentia, Productio, Extuberantia, Projectura, Enalcentia,

† Rostra, Glandes.

* ὐπτες, ὄφρυες, ἄμβονες, χεῖλη, Labra,

chiefly on the Description of the adult Skeleton, in which the Union of these Parts is so very intimate that scarce any Vestige remains of their former Separation, I shall retain the common Appellation of *Apophyse* or *Process* to all such Protuberances; but shall remark the principal ones that have no just Title to this Name, when they occur in the Description of particular Bones.

In a great many of the Bones there are Cavities: If these are deep, with large Brims, Authors name them *Cotylæ*†; if they are superficial, they obtain the Designation of *Glenæ* or *Glenoid*. Which general *Classes* are again divided into particular *Species*: Of which *Pits* are small roundish Channels sunk perpendicularly into the Bone; *Furrows* are long narrow Canals formed in the Surface; *Niches* or *Notches*, small Breaches in the Bone; *Sinuosities*, broad but superficial Depressions without Brims; *Fossæ*, large deep Cavities which are not equally surrounded by high Brims; *Sinuses*, large Cavities within the Substance of the Bones, with small Apertures; *Foramina* or Holes, Canals that pierce quite thro' the Substance of the Bones. When this last Sort of Cavity is extended any large Way within a Bone, the middle Part retains the Name of *Canal*, and its Extremities are called *Holes*.

The Uses of the Cavities are very numerous; such as, to allow Heads of Bones to play in, to lodge and defend other softer Parts, to afford a safe Passage for Vessels,

† Κοτυλίδες, ὀξύβλαφοι, Acetabula, Pixides, Buccellæ,

Vessels, Muscles, &c. To mention more would engage us too much in the History of particular Bones, which more properly belongs to the Demonstration of the *Skeleton*, where we shall have occasion to observe these several Species of Cavities.

To far the greater Number of Bones, whose Extremities are not *Epiphyses*, joined to other Bones by an immoveable Articulation, there are smaller ones annexed, which afterwards become scarce distinguishable from the Substance of the Bone itself. These are called *Epiphyses* or *Appendices* *. Some Bones have one, others have two, three or four of these *Appendices* annexed, by the means of Cartilages which are of a considerable Thickness in Children, but by Age become thinner, the Ossification proceeding from the Extremity of the Bone on one Side, and from the *Epiphyses* on the other, till at last, in Adults, the Place of their Conjunction can scarce be observed on the external Surface: And, as *Winslow* (a) observes, it is only sometimes that we can then see any Mark of Distinction in the *Cancelli*.

The *Epiphyses* are united chiefly to such Bones as are destin'd for frequent *uses*, and violent Motion; and for this Purpose they are wisely framed of a larger Diameter than the Bone they belong to; for by this means the Surface of Contact between the two Bones of any Articulation being increased,

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* *Applantatio, Additamentum, Adnascentia, Adnexus, Perone.*

(a) *Exposition Anatomique de Corps Humain Traité des Os secs, § 116,*

creased, their Conjunction becomes firmer, and the Muscles inserted into them act with greater Force, by reason of their Axes being further removed from the Center of Motion. These Advantages might indeed have been obtained by the Expansion of the Extremity of the Bone itself to a Thickness equal to that of the *Epiphyses*; but then the constant Separation of new Plates to form so wide a cellular Structure, must have left the solid Sides of the Bones so thin, as to yield easily, either to the Action of the Muscles fixed to them and passing over them, to the Weight several of them are obliged to support, or to the Application of any other external Force.

Besides these Uses, the *Epiphyses* serve other Purposes; such as, securing the Ligaments of the Articulations, which rise out from between the Bones and them; for as soon as these Parts are intimately conjoined, the Ligaments insinuated betwixt them must have a much stronger Connection than they could have to the smooth Surface of the Bones, as *Columbus* (a) and *Fallopins* (b) have remarked. And then the *Epiphyses* hinder the Fibres of the Bone to run out too far, and to join with its neighbouring Bone, which would deprive us of all Motion, while the Fibres of the *Epiphyses*, which seem not so much disposed in a straight Direction, are prevented from the like Inconvenience, by the Interposition of Cartilages. That we would be liable to such an Inconvenience without this Mechanism, is evident from the Observations of the bony Processes, which

(a) De re Anatomica, lib. 1. cap. 2.

(b) Exposit. de ossibus, cap. 11.

which jet out preternaturally from Bones when the *Periosteum* is destroyed, and they are not restrained in their Growth; and from the Lameness which happens so frequently after the Erosion of the Cartilages, when the Fibres of two Bones design'd for Motion run one into another, which is the worst Species of *Anchylosis*, as every Day happens in Wounds of the Joints, and Ulcers from the *Paidarthrocace*, *Scrophula* and *Spina ventosa*. The same Disease likewise frequently follows the Ossification of these Gristles from old Age or any other Cause. Two very remarkable Instances of an universal *Anchylosis* are related by *Columbus* (a) and *Deslandes* (b): The first Author says, he saw a Skeleton whose Bones from the Head to the last Joints of the Toes were all immoveably united; and the other gives the History of a Child near two Years old, that had not a moveable Joint.

We may here observe, with *Vesalius* (c), that several Processes, as the *Trochanters* of the Thigh and Spine of the *Scapula*, have *Epiphyses*; and that from the *Epiphyses* frequently Processes rise out, as at the lower Extremity of the *Femur*, *Ulna*, *Tibia*, &c.

It may perhaps seem improbable, that such hard Bodies as the Bones should be so luxuriant and sprouting. But this will not appear so surprising when it is demonstrated, that however solid and compact adult Bones are, yet they were
ONSSIFI-
CATION.
 once

(a) De re Anatomica, lib. 15.

(b) Histoire de l'Acad. des Sciences 1716.

(c) De humani corporis fabrica, lib 1. cap. 3.

once Cartilages, Membranes, nay a mere Jelly. This needs no further Proof, than repeated Observations of *Embryos* when dissected: And how much more tender must the Bones be before that Time, when neither Knife nor Eye is capable to discover the least Rudiments of them? By degrees they become more solid, then assume the Nature of Gristles, and at last ossify: Which is brought about, partly by the Bones being more than any other Parts exposed to the strong Pressure of the great Weights they support, to the violent Contraction of the Muscles fixed to them, and to the Force of the Parts they contain, which endeavour to make Way for their own further Growth. By all this pressing Force the solid Fibres and Vessels of the Bones are thrust closer, and such Particles of the Fluids conveyed in these Vessels as are fit to be united to the Fibres, are sooner and more firmly incorporated with them, while the remaining Fluids are forcibly driven out by the Veins to be mixed with the Mass of Blood. In consequence of which we observe, that gradually, as the Bones harden, the proportional Number and Largeness of their Vessels decrease. From which again we can understand one Reason of the Bones of young Creatures sooner reuniting after a Fracture, than those of old. From this also we can deduce the Cause of Horses, Bullocks, and other young Creatures of a large Brood, decaying in their Size, when put too soon to hard Labour.

That the ossifying of Bones does depend much on such a Pressure, seems to be evinced from the frequent Examples we meet with of
other

other Parts turning bony, when long exposed to the compressing Force of the surrounding Parts, or when they are subjected to the like Circumstances by their own frequent and violent Contraction. Witness the Bones found so frequently near the Base of the Heart in some old Men, and in several other Creatures. Nay the muscular Substance of the Heart has been ossified in such Instances of which *Chefelden* (a) and *Garengeot* (b) give us; and the Arteries of old Men often become bony. The Cartilages of the *Larynx* are generally ossified in Adults. In Beasts of Burden the Cartilages between the *Vertebrae* of the Back and Loyns very often change into complete Bones, and being intimately united with the *Vertebrae*, the whole appears one continued Bone. Nor is the *Periosteum* exempted from such an Induration; for *Peyer* (c) tells us, he divided this Membrane into several bony Plates.

To confirm this Argument still further, we may observe, that Bones begin their Ossification at the Places where they are most exposed to these Causes, viz. in the cylindrical Bones from a middle Ring, and in the broad ones at or near their Center, from one or more distinct Points. The Reason of which is, that these Parts are contiguous to the Bellies of the Muscles annexed to the Bones, where the swelling of these moving Powers is greatest. What the Effects of this may be, let any judge who view some of the Bones, as the *Scapula* and *Ilium*,

(a) Anatomy, Book 1. Chap 1.

(b) Histoire de l'Acad. des Sciences 1726.

(c) Ephemerid, German, Decur. 2. Ann. 7. Observ.

Ilium, which are on each Side covered with Muscles; how compact and thin they are in Adults, where the Bellies of the Muscles were lodged, whereas in Children they are thicker. But this being the middle Part of these Bones where the greatest Number of Fibres is, this particular Place would have been much thicker in Adults, had not this forcible Cause been applied, which has not had such Effects in Children whose Muscles have not been much exercised. Besides, if we allow that all the Parts of a Bone are equally increased by the constant Supply of new Particles, each Fibre and every Particle of a Fibre will endeavour to make way for its own Growth, by pushing the one next to it; and consequently by far the greatest Pressure will be on the Middle: Wherefore the Particles there will be made most firm: And here it is that Bones begin their Ossification. Lastly, The Pulsation of the medullary Arteries, which enter the Bones near to this middle Part, may, as Authors have alledged, contribute perhaps somewhat to this Induration.

From the Effects of Pressure only it is, that we can account for the Bones of old People having their Sides so much thinner, yet more dense and solid, while the Cavities are so much larger than in young Bones; and for the Prints of Muscles, Vessels, &c. being so much stronger marked on the Surfaces of Bones according to their Ages, if they belong to People of near the same Condition of Life, or if they belong to those of the same Age, according to the Labour or Exercise they have had. The Bones of old People and of those accustomed

stomed to Labour being more strongly impressed than those of young Folks, and of such who have lived in Indolence and Inactivity.

It is also probable, that Ossification depends on the Vessels of the Bones being so disposed, and of such Diameters, as to separate a Liquor, which may easily, when deprived of its thinner Parts, turn into a bony Substance; as seems plain from the Observation of the callous Matter separated after Fractures and Ulcers, where Part of the Bone is taken out: For in these Cases this Liquor hardens, and often cements the two Extremities of a Bone, tho' at a good Distance from each other; as I have seen happen in two or three Cases, and of which there are abundance of very remarkable Instances handed down by Authors. One, scarce inferior to any of them, was communicated to me by Mr. *Laing* Surgeon at *Jedburgh*, and is now published (a), of a Child, whose *Tibia* he took out, leaving little more than the *Epiphyses* at each Extremity; all that he took away of the Bone was supplied by a bony Substance, on which his Patient walks easily and firmly.

Perhaps both the Causes of Ossification above mentioned may be assisted by the Nature of the Climate People live in, and the Food they use. Whence in hot Countries the Inhabitants sooner come to their Height of Stature, than in the Northerly cold Regions: And thence seems to have arisen the common Practice among the Ladies of making Puppies drink Brandy or Spirit of Wine, and of bathing

(a) Medical Essays and Observations published at *Edinburgh*, Vol. I. Art. 23.

ing them in these Liquors, to prevent their growing big. Nay it has been observed, that much Use of such Spirits has occasioned Parts naturally soft to petrify in some, and to ossify in other People of no great Age. Witness the Cases related by *Littre* (a) and *Geoffroy* (b).

From the foregoing Account of the Diseases. Structure of Bones, and of their Ossification, we may understand the Reasons of the following Phenomena.

How the natural Colour of the Bones may be changed by some Sorts of Food, as has been observed by Mr. *Belchier* (c).

Why the Bones of some People are so long of hardning, and in others never completely indurate.

Why in such whose Ossification is very slow, the Bones are generally thicker in proportion to their Lengths, especially at their Extremities, as in the *Rickets*.

How by Diseases hard firm Bones have become soft and pliable, as is related by *Courtial* (d), *Gagliardi* (e), *Petit* (f), and a great many Authors, from whom a considerable Collection may be read in the *Ephemerides Germanicæ* (g).

How in some Cases the Bones may waste and diminish, an Instance of which we have from

(a) Histoire de l'Acad. des Sciences 1706.

(b) Memoires de l'Acad. des Sciences 1706.

(c) Philosoph. Transact. N^o. 442. Art. 8. and N^o. 443. Art. 2.

(d) Histoire de l'Acad. des Sciences 1700.

(e) Anatom. ossium. cap. 2. observ. 3.

(f) Memoires de l'Acad. des Sciences 1722.

(g) Decur. 1. ann. 1. obs. 37. & schol. Decur. 2. ann. 7. obs. 212, 235. Decur. 3. ann. 2. obs. 3.

from *Cheselden* (a), and in that Case of *Courtial* just now mentioned.

How the Bones may become solid all through, without any Appearance of *Cancelæ*, as *Ruyſch* (b) has observed.

Why the *Epiphyses* separate from the Bones in some Diseases (c).

How *Nodes*, *Tophi* and *Exostoses* happen after the Erosion of the external Plates of the Bones in the *Lues Venerea*, *Scurvy*, *Rheumatism* and *Gout*.

What occasions such Difficulty sometimes in curing fractured Bones, or why they never reunite, tho' they are reduced, and all proper Means towards a Cure are used (d).

Why the Effects of eroding acrid Matter on Bones may be very different, and consequently why there may be several more species of carious Bones than are commonly described.

How several Liquors may serve to soften, and even dissolve their Substance.

Whoever is desirous to know, in what Time and Order each Bone and its several Parts begin to assume a bony Nature, let him consult *Kerckringius* (e), who gives us the Delineations of Abortions from three Days after Conception, and traces the Ossification of the Bones from three Weeks and a Month, till the Time of the

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Birth:

(a) Anatomy, Book I. Chap. I.

(b) Thesaur. 2. Arc. 5. Thes. 3. Loc. 1. N^o. 5, Thes. 9. N^o. 2. not. 3.

(c) Memoires de l'Acad. des Sciences 1699.

(d) Meckren. Observ. Medico-chirurg. Obs. 71. Ruyſch Advers. Dec. 2. § 2. Observ. Anat. Chir. Obs. 4.

(e) Anthropograph. Ichnograph. & Osteogenea Foetuum

Birth: To whom should be added *Coiterius* (a) and *Eyssonius* (b). A pretty complete Account of this Subject might also be collected out of *Ruyssch's* Works, where some of the Mistakes committed by the former Authors are corrected, and several more Particulars to make the Account of the *Osteogenea* more accurate, have since been added by *Nesbitt* (c) and *Albinus* (d).

I must refer to the Authors now quoted for the more curious Part of the human Osteogeny, not having Preparations enough to give such a full History of it as is done by them; but I shall endeavour to explain the more useful and necessary Part of this Osteogeny, by subjoining to the Description of each particular Bone of an Adult, its particular State in ripe Children, that is, in such as are born at the ordinary Time, and shall point out what Parts of each are afterwards joined in Form of *Epiphyses*. This, with the following general Rules, seems to me sufficient for understanding what of this Subject is necessary in the Practice of Physick and Surgery.

1. Wherever I mention any Parts being cartilaginous; or their being still separable from the other Parts of their proper Bone, I would be understood to hint, that about seven or eight Years of Age, such Parts are ossified and united to their proper Bones, unless when it is said, that they are afterwards formed into *Epiphyses*.

2. Such

(a) De ossibus fœtus abortivi.

(b) De Ossibus Infant. cognoscend. & curand.

(c) Human Osteogeny explained.

(d) *Leones ossium fœtus humani accedit osteogeniæ prævis historia.*

2. Such as become *Epiphyses*, are generally ossified at seven or eight Years old, but being for the most Part moistned by *Synovia*, their external Surface is still somewhat cartilaginous, and they are not yet united to their Bones.

3. At eighteen or twenty Years of Age, the *Epiphyses* are entirely ossified, and have blended their Fibres so with the Body of the Bone, as to make them inseparable without Violence.

4. The Ridges, Depressions, and other Inequalities of Bones being principally owing to the Actions of Muscles fixed to them, and situated near them, it will follow, that wherever Muscles have acted least, there the Bones will have fewest Inequalities; and therefore that we are to expect these Inequalities to increase according to People's Ages.

The Knowledge of this Part of the *Osteogeny*, which I have undertaken thus to explain, I think necessary to prevent dangerous Mistakes in the Cure of several Diseases: As for Example, without this Knowledge, the Separation of an *Epiphysse* might be mistaken for a Fracture or Luxation; the Interstice of two Parts of a Bone not yet conjoined might be judged to be a Fissure; a *Diastasis*, or other violent Separation of such disjoined Pieces of a Bone, might be thought a great Fracture; and the Protrusion of one Piece, or its overloping any other, could be mistaken for an Excrescence or *Exostosis*. Such Errors about the Nature of a Disease would give one very different Indications of Cure, from what he would have, if he really understood his Patient's Case. And very often the Knowledge of the different Inequalities on the Surfaces of Bones, must direct

us in the Execution of what is proper to be done to cure several Diseases of Bones.

Having thus considered the
ARTICULATIONS. Bones as single, we ought next to shew the different Manner of their Conjunctions*. To express these, Anatomists have contrived a great Number of technical Terms, about the Meaning, Propriety and Classing of which there has unluckily been great Variety of Opinions. Some of them it is necessary to retain, since they serve to express the various Circumstances of the Articulations.

The Articulations are most commonly divided into three Classes, the *Symphysis*, *Synarthrosis*, and *Diarthrosis*.

The *Symphysis*, which properly signifies the Concretion or growing together of Parts; when used to express the Articulations of Bones, does not seem to comprehend under the Meaning generally given to it, any thing relating to the Form or Motion of the conjoined Bones, but by it Authors only denote the Bones to be connected by some other Substance; and as there are different Substances which serve this Purpose, therefore they divide it into the three following Species,

1. *Synchondrosis* †, when a Cartilage is the connecting Substance; thus the Ribs are joined to the *Sternum*; thus the Bodies of the *Vertebrae* are connected

* Σύνταξις, σύνθεσις, συμβολή, ὁμιλία, Compositio, Connexio, Articulatio, Conjunctio, Nodus, Commissura, Structura, Compages.

† Amphiarthrosis.

sted to each other, as are likewise the *Ossa Pubis*.

2. *Synneurosis*, or *Syndesmosis*, when Ligaments are the connecting Bodies, as they are in all the moveable Articulations. *Synneurosis.*

3. *Syssarcosis*, when Muscles are stretched from one Bone to another, as they must be where there are moveable Joints, and frequently too where Bones are not moveable. *Syssarcosis.*

The second Class of Articulations the *Synarthrosis*, which is said to be the general Term by which the immoveable Conjunction of Bones is expressed, is divided into two Kinds. *Synarthrosis.*

1. The *Suture* † is that Articulation where two Bones are mutually indented into each other, or as if they were sowed together, and is formed by the Fibres of two Bones meeting while they are yet flexible and yielding, and have not come to their full Extent of Growth, so that they mutually force into the Interstices of each other, till meeting with such Resistance as they are not able to overcome, they are stopped from sprouting out farther or are reflected; and therefore, these Indentations are very different both in Figure and Magnitude. Thus the Bones of the Head are conjoined; thus likewise the *Epiphyses* come before the full Connection to be joined with the Bones. Under this Title of *Suture*, the *Harmonia* of the Antients may be comprehended, since, *Harmonia.*

† *ῥαφή.*

as *Vesalius* (a) has well remarked, scarce any unmoved Bones are joined by plain Surfaces.

2. *Gomphosis* * is the fixing one Bone into another, in the same Manner as a Nail is fixed in a Board; thus the Teeth are secured in their Sockets.

To these may be added *Keil's* (b) *Schindylesis* or *Ploughing*, when a thin *Lamella* of one Bone is received into a long narrow Furrow of another; thus the *Processus azygos* of the *sphenoid* Bone, and the nasal Process of the *ethmoid* Bone, are received by the *Vomer*.

The third Class or *Diarthrosis* † *Diarthrosis*. is the Articulation where the Bones are so loosely connected as to allow a large Motion. This again is subdivided into three Sorts.

The first of these Kinds of *Diarthrosis* is *Enarthrosis*, or the Ball and Socket, when a large Head is received into a deep Cavity, as the Head of the *Os Femoris* is into the *Acetabulum Coxendicis*.

The next Species is *Arthrodia*, *Arthrodia*. when a round Head is received into a superficial Cavity, as in the Articulation of the Arm-bone and *Scapula*: Both this and the former Sort of Articulation allow Motion to all Sides.

The last Sort is *Ginglimus* ‡, *Ginglimus*. which properly signifies the Hinge of a Door or Window; in it, the Parts

(a) Observ. Fallop. examen.

* Conciavatio.

(b) Anat. Chap. 5. Sect. 3.

† *Ἀπαρθρώσις*, Dearticulatio, Abarticulatio,

‡ *Ἀρθρώσις*, Articulatio mutua.

Parts of the Bones mutually receive and are received, and allow of Motion two Ways; Tradesmen call it *Charnal*. The *Ginglimus* is generally divided into these three Kinds, to which *Baker* (a) gives the Names of *proximus*, *longus* and *compositus*. The first is when a Bone has several Protuberances and Cavities, which answer to as many Cavities and Processes of the other Bone with which it is articulated, as in the Conjunction of the *Femur* with the *Tibia*.

The *Second* Species is, when a Bone receives another at one End, and is received by the same Bone at the other Extremity, as in the Articulations of the *Radius* and *Ulna*.

The *Last* Sort is, when a Bone receives another, and is received by a third, as in the oblique Processes of the *Vértebrae*.

When I first mentioned the Articulations of Bones, I said there were different Opinions concerning the Use of these technical Words applied to the Conjunctions of Bones, *e.g.* It has been said, that *Symphysis* should be the Name for the immoveable Articulations, and that by *Synarthrosis* should be understood the Conjunction of Bones by some connecting *medium*.--- Those who have taken *Symphysis* in the Sense I did, of its expressing the Conjunction of Bones with a connecting Substance, have disagreed in their Definition of it, some inserting, and others leaving out its allowing Motion.--- Where they have agreed in their Definition, they have not been of the same Mind concerning the Species of it. For several think the

Syfar-

(a). *Curs. osteolog. Demonstr. 1.*

Sysarcofis and *Syndesmosis* applicable to so many Joints which are universally allowed to be classed under the *Diarthrofis*, that it must create Confusion to name them by any Species of the *Symphysis*.— Few keep to such a general Definition of the *Synchondrofis* as I have done, and whether they determine it to allow no Motion, or an obscure or a manifest one, bring themselves into Difficulties, because there are Examples of all these three Kinds.--- Some again, by too nicely distinguishing obscure and manifest Motions of Bones, have blended the *Synarthrofis* and *Diarthrofis*, and from thence have branched out the different compound Species of Articulations that may be formed of them so far, that they could find no Examples in the Body to illustrate them by. —It would be tedious to enumerate more of the jarring Opinions, and it would be far more so to give a Detail of the Arguments used by the Disputants. It is sufficient for my Purpose, that it is understood what Sense I take these technical Terms in, which I do in the following Manner.

When I mention the *Symphysis* or *Synarthrofis*, or any Species of them, I shall always understand them according to the Explication I have first given of them. But tho' the Account already given of the *Diarthrofis*, or Articulation of moveable Bones, has been almost universally received as just, yet seeing it does not comprehend all the moveable Articulations of the Body, and one of its Species does not answer to any Notion we can have of the Conjunction of two Bones, I must beg leave to change the Definitions and Kinds of these Joints.

I would call *Diarthrosis* that Conjunction of Bones, whereby they are fitted for Motion, being each covered with a smooth Cartilage, connected by one or more common Ligaments, and lubricated with *Synovia* at the conjoined Parts. In which Definition, I have no Regard to the Quantity of Motion which they really do perform; the Motion being often confined or enlarged by some other Cause not immediately depending on the Frame of the two Surfaces of the Bones, forming the particular Joint, which then is considered.

The first Species of the *Diarthrosis*, viz. the *Enarthrosis* or Ball and Socket, I would define more generally than above, That Articulation where a round Head of one Bone is received into a Cavity of another, and consequently without some foreign Impediment, is capable of Motion to all Sides: Examples of this Kind are to be seen in the Articulation of the Thighbone and *Ossa Innominata*; of the Arm-bone and *Scapula*; *Astragalus* and *Os Naviculare*; *Magnum* or *Capitatum* of the Wrist, with the *Scaphoides* and *Lunare*; first Bone of the Thumb, with the second, &c.

The second Sort or *Arthrodia* differing only in the preceeding Account from the *Enarthrosis*, in the Cavity being more superficial, which makes no essential Difference, especially seeing that in the recent Subject, Cartilages or Ligaments supply the Deficiency of Bone, ought in my Opinion to be called with *Vesalius* (a), that

(a) De corp. human. fabrica, lib. 1. Cap. 4.

46 *Of the Bones in general.*

Articulation of two Bones adapted for Motion, where it is not at first Sight obvious which of the two has the Head or Cavity, or where they are joined by plain Surfaces or nearly so, such is the Conjunction of the *Clavicle* with the *Scapula*; *Ossa Cuneiformia* with the *Os Naviculare*; *Metatarsal* Bones with the *Ossa Cuneiformia*, &c. From the Nature of this Sort of Joint, it is plain that very great Motion cannot be allowed without the Bones going farther out of their natural Situation, than is convenient or safe.

Ginglimus I would reckon that
Ginglimus. Articulation, by the Form of which, the Motion of the conjoined Bones, must be mostly confined to two Directions, which hinges of Doors are. The
Trochoides. first Species of this is the *Trochoides*, when the one Bone turns on the other, as a Wheel does on its Axis; thus the first *Vertebra* of the Neck, moves on the Tooth-like Process of the second. This is most commonly neglected by late Writers, tho' it is the most proper Kind of *Ginglimus*.

The second Species should be e-
Proximus. steemed that Articulation, where, within the same common Ligament; several prominent and hollow Surfaces of two Bones move on each other, as in the Knee, Elbow, &c.

The third Sort of *Ginglimus*, is when
Longus. two Bones are articulated to each other at different Parts, with a distinct *Apparatus* of the motory Machines at each, such is the Articulation of the *Os Occipitis* with the first *Vertebra* of the Neck, of any two contiguous

tiguous *Vertebrae* by their oblique Processes, of the Ribs with the Body and transverse Process of the *Vertebrae*, of the *Radius* with the *Ulna*, *Tibia* with the *Fibula*, *Astragalus* with the *Calcaneum*, &c.

What is commonly enumerated as the third Kind of *Ginglimus*, I would entirely throw out; for in considering the Conjunction of a Bone with two others, as in the common Example of a *Vertebra* joined with the one above and below, each ought to be observed distinct; otherwise we might with the same Property esteem the Articulations that the long Bones, such as the *Femur*, *Tibia*, *Humerus*, &c. have at their different Extremities, as one Articulation, which readily would be granted to be absurd.

If the moveable Bones were not connected and kept firm by some other strong Substance, they would be luxated at every Motion of the Joints; and if the hard rough unequal Surfaces of such Bones were to play on each other, they would not only produce a Difficulty in their Motion, but would occasion too great Loss of the bony Substance: Therefore the Almighty and infinitely wise Author of our Beings has framed *Ligaments* to obviate the first, and *Cartilages* to prevent the other Inconveniency; but, because *Ligaments* and *Cartilages* would turn rigid, inflexible and rough, unless they were kept moist, a sufficient Quantity of proper Liquors is supplied for their Lubrication, and to preserve them in a flexible State. Seeing then these Parts are so necessary to the Articulations, I shall next consider their Structure, Situation

tuation and Uses, as far as they are subservient to the Bones.

Ligaments * are white flexible Bodies, thicker and firmer than Membranes, and not so hard or firm as Cartilages, without any remarkable Cavity in their Substance, difficultly stretched and with little Elasticity, serving to connect one Part to another, or to prevent the Parts to which they are fixed from being removed out of that Situation which is useful and safe. I have been the more particular in this Description, attempting to prevent the Hazard of young Anatomists having their Minds perplexed and Ideas confounded, in determining to what Class several Substances observable in the human Body, are to be reduced, whether, to wit, they ought to be called Membranes, Ligaments or Cartilages, which there is often too little Care taken to characterize sufficiently, and the Examples commonly mentioned do not illustrate enough: It must however be acknowledged, that some Bodies have their Texture and Uses so blended between the Membrane and Ligament, or between this last and the Cartilage, as to render their Names very ambiguous; I would hope such a Description as is given above, would in some Measure prevent this Confusion.

After Maceration in Water, the Layers of Ligaments can easily be divided, and each ligamentous Layer appears composed of Fibres, the largest of which are disposed in a longitudinal Direction.

The

(*) Σύνδεσμοι, νεύρα, Copulae, Vincula,

The Blood Vessels of the Ligaments are very conspicuous after a tolerable *Vessels.* Injection. Such Ligaments as form the Sides of Cavities, have numerous Orifices of their Arteries opening upon their internal Surface, which are constantly throwing out a fine thin Lymph there, as evidently appears upon Pressure after the Moisture has been rubbed off with a dry Cloath; and it is reasonably to be presumed from what is to be observed in other Cavities, that there are corresponding Veins to absorb Liquors from the Cavities which the Ligaments form.

Authors generally say, that Ligaments are insensible, and consequently *Nerves.* it may be inferred that they have no Nerves bestowed on them; but the violent racking Pain, felt on the least Motion of a Joint labouring under a *Rheumatism*, the Seat of which Disease seems often to be in the Ligaments, and the insufferable Torture occasioned by a Collection of acrid Matter in a Joint, or by *Tophi* in the Gout, would persuade us of their being abundantly supplied with Nerves.

The Ligaments which serve to connect the movable Bones, commonly *uses.* rise from the Conjunction of the *Epi-* *physes* of the one Bone, and are inserted into the same Place of the other; or where *Epi-* *physes* are not, they come out from the *Cervix*, and beyond the *Supercilia* of the articulated Bones; and after such a Manner in both Cases, as to include the Articulation in a Purse or Bag, with this Difference, depending on their different Motions, that where the Motion is

E

only.

only to be in two Directions, the Ligaments are strongest on those Sides towards which the Bones are not moved; and when a great Variety of Motions is designed to be allowed, the Ligaments are weaker than in the former Sort of Articulations, and are near of the same Strength all round.

Besides these common circular Ligaments of Joints, there are in several Places particular ones, either for the firmer Conjunction of the articulated Bones, or for restraining and confining the Motion to some one Side; such are the cross ones of the Ham, the round Ligament of the Thigh, &c.

From this Account of the Ligaments, *Fabricius ab Aquapendente's* (a) Observation will appear just, that *ceteris paribus*, in whatever Articulation, the Ligaments are few, long and weak, the Motion will be more free and quick, but Luxations will frequently happen; and on the contrary, where the Ligaments are numerous, short and strong, the Motion will be more confined, but such a Joint will be less exposed to Luxations.

Ligaments are also of Service to the Bones in several other Respects; as for Instance, they supply the Place of Bones in several Cases to Advantage; thus the Parts in the *Pelvis* are more safely supported below by Ligaments, than they could have been by Bone. The Ligaments placed in the great Holes of the *Ossa Innominata*, and between the Bones of the Fore-arm and Leg, afford convenient Origin to Muscles. Immoveable Bones are more firmly

(a) De Articul. Part. utilit. pars tertia.

firmly connected by them; of which the Conjunction of the *Os sacrum* and *Ossa Innominata* is an Example; and they afford a Socket for moveable Bones to play in, as we see Part of the *Astragalus* does on the Ligaments stretched from the Heel-bone to the *Scaphoid Bone*.

Cartilages * are solid, smooth, white elastick Substances, between the Hardness of a Bone and Ligament; and covered with a Membrane named *Perichondrium*, which is a-kin to the *Periosteum* of the Bones.

CARTILAGES.

The Cartilages are composed of Plates, which again are formed of Fibres disposed much in the same Way as Bones have them, as might be reasonably concluded from observing all Bones in a cartilaginous State before they ossify; and from seeing, on the other Hand, so many Cartilages become bony: This may be still farther confirmed, by the *Exfoliation* which Cartilages are subject to, as well as Bones; and a Demonstration can be given of this Structure, after boiling, burning, and exposing Cartilages to the Weather.

Plates and Fibres.

The Blood-vessels and Nerves are distributed to the Cartilages, in much the same Manner as to the Bones.

Vessels and Nerves.

While Cartilages are in a natural State, it is to be remarked; *First*, That they have no Cavity in their Middle for Marrow. *Secondly*, That their exterior Surface is softest, which renders them more flexible; from this it is, that injected Liquors seldom reach to their

middle solid Part, tho' the Vessels on their Surface are easily filled. And *Lastly*, That, as the specifick Gravity of Cartilages is near a third less than that of Bones, so the Cohesion of their several Plates is not so strong as in Bones, whence Cartilages when laid bare in a living Creature, by a Wound or Ulcer, are not only more liable to corrupt, but exfoliate much sooner than Bones do.

Cartilages seem to be principally kept from Ossifying, either by being subjected to alternate Motions of Flexion and Extension, the Effects of which are very different from any Kind of simple Pressure, or by being constantly moistned; thus the Cartilages on the articulated Extremities of the great Bones of the Limbs, and the moveable ones placed between the moving Bones in some Articulations, which are obliged to suffer many and different Flexions, and are plentifully moistned, scarce ever change into Bone, while those of the Ribs and Larynx are often found ossified. In the Cartilages of the Ribs, again, we see that the middle angular Part, which is constantly in an alternate State of Flexion and Extension, by being moved in Respiration, never misses to be the last of becoming bony. And in the *Larynx*, the *Epiglottis*, which is oftner bended and more moistned than the other four Cartilages, seldom is ossified, while the others as seldom escape it in Adults.

The Cartilages (unless when some of these Causes operate) begin to ossify on their external Surface, where the greatest Pressure of numerous Vessels, and of external Forces must be, and the Ossification proceeds internally till the

the *Cancelli* are at last formed, when a sort of Marrow is deposited into them : While this Change is a bringing about in the Substance of the Cartilages, their Blood-vessels gradually appear bigger towards their internal Substance, and less on the external. This Change of a Cartilage from a natural State to its becoming Bone is at first View surprising, and, so far as I know, has scarce been attempted to be explained ; which I mention only, to have some Plea for an Apology, if I should be thought to have failed in accounting for this *Phenomenon*.

That we may be able to reason on some Principles, it will be necessary to add some more Observations of Facts to those already mentioned. Such are the following : As the Plates of Cartilages separate more easily than those of Bones ; so the Cohesion of the bony Plates is always strong in Proportion to the Solidities of the Bones, as may be evidently seen in preparing different Bones of Adults, or the same Bones of young and old Subjects, in order to unravel their Texture, or by comparing the Time which such Bones take to exfoliate. Next, I wou'd repeat what was formerly remarked, That as Creatures advance in Age, the solid Sides of the Bones still turn firmer and harder, but thinner, and the *Cancelli* within them increase proportionally. Lastly, That the hardning or Ossification of Bones depends much upon the solid Particles being pressed closer together, while the fluid ones are forced out.

*Account of
their Ossifi-
cation.*

The Cartilages being naturally of such firm

Substance, and of a Composition a-kin to the Bones, will by a constant Pressure gradually acquire greater Solidities; and this Change will be made soonest and most remarkably, where this Pressure is greatest, that is, at their external Surface. The exterior Plates, when ossified, are more compact and dense than formerly, and therefore they will have a stronger Power of attracting those in contact with them; while the Branches of Vessels distributed to the first ossified Plate, and those that run in the Interstices of the Fibres of this and of the Plate next to it, being now more compressed than formerly, will have a less Quantity of Fluids passing through them, and consequently the other Branches will receive a proportionally larger Quantity; the *Momentum* of which, joined to that Power of Attraction or Force of Cohesion, increased by the greater Solidities of the Plates, will increase the Pressure upon the more internal Plates, and hasten their hardning; after which these last Plates will produce the same Effects on the other contiguous to them: And thus the Ossification must go on, till all are become bony. The Body thus changed, will have its former Dimensions, or near so, because its external Part ossified first, and being rigid, yields little or nothing to the Powers that draw it towards the Axis of the Bone; but seeing the new Particles added from the circulating Fluids during the Ossification, do not compensate for the Condensation which all the Particles undergo, and thereby the Plates occupy less Space than they did while in a cartilaginous State, therefore a Cavity will be left in the Middle; and

as all the Plates cohered and had cross Fibres joining them, many of these Fibres will be stretched irregularly from one Side of the Cavity to the other, and therefore form the *Cancelli*. The Branches of the Vessels formerly distributed to the Plates being now much lessened, the remaining Branches, which run transversely, will consequently be proportionally increased, come to be very conspicuous, and are dispersed every where in the Cavity, to serve for the Secretion of Marrow.

The Cartilages subservient to Bones are, as *Celsus* (a) observes, *Situation*. sometimes found on the Extremities of Bones which are conjoined to no other; but are never wanting on the Ends and in the Cavities of such Bones as are designed for Motion: And in more than one Instance, Cartilages are interposed between such other Cartilages as cover the Heads and Cavities of articulated Bones; nay they are also placed between immovable Bones.

The Uses of Cartilages, so far as they regard the Bones, are, to allow by their *Use*. Smoothness such Bones as are design'd for Motion to slide easily without Detrition, while by their Flexibility they accommodate themselves to the several Figures necessary in different Motions, and by their Elasticity they recover their natural Position and Shape as soon as the Pressure is removed: This springy Force may also assist the Motion of the Joint to be more expeditious. To these Cartilages we chiefly owe the Security of the moveable
Arti-

(a) De Re medic, lib, 8. cap. 1,

Articulations: For without them the bony Fibres would sprout out, and intimately coalesce with the adjoining Bone; whence a true *Anchylosis* must necessarily follow; which never fails to happen when the Cartilages are eroded, as was already observed. The movable Cartilages interposed in Joints serve to make the Motions both freer and more safe than they would otherwise be. Those placed on the Extremity of Bones that are not articulated, as on the Spine of the *Ilium*, Base of the *Scapula*, &c. serve to prevent the bony Fibres to grow out too far. Cartilages sometimes serve as Ligaments either to fasten together Bones that are immoveably conjoined, such are the Cartilages between the *Os sacrum* and Haunch-bones, the *Ossa pubis*, &c. or to connect Bones that enjoy manifest Motion, as those between the Bodies of the true *Vertebrae*, &c. And very often Cartilages do the Office of Bones to greater Advantage than these last could; as in the Cartilages of the Ribs, the Cartilages which supply Brims of Cavities, &c.

The Liquor which principally serves to moisten the Ligaments and Cartilages of the Articulations is supplied by Glands, which are commonly situated in the Joint after such a Manner as to be gently pressed, but not destroyed by its Motion. By this means, when there is the greatest Necessity for this Liquor, that is, when the most frequent Motions are performed, the greatest Quantity of it must be separated. These Glands are soft and pappy, but not friable: They are mostly of the conglomerate Kind,

Kind, or a great Number of small Glandules are wrapt up in one common Membrane. Their excretory Ducts are long, and hang loose, like so many Fringes, within the Articulation; which by its Motion and Pressure will prevent Obstructions in the Body of the Gland, or its Excretories, and will promote the Return of this Liquor, when fit to be taken up by the absorbent Vessels, which must be in the Joints as well as in the other Cavities of the Body; and at the same time the Pressure on the excretory Ducts hinders a superfluous unnecessary Secretion, while the fimbriated Disposition of these Excretories will not allow any of the secreted Liquor to be pushed back again by these Canals towards the Glands, as *Cowper (a)* has justly remarked. Besides these conglomerate Glands, we meet sometimes with small simple *Folliculi*, observed by *Morgagni (b)*, that are full of Liquor.

Upon pressing these Glands with the Finger, one can squeeze out of their Excretories a mucilaginous Liquor, which somewhat resembles the White of an Egg or *Serum* of the Blood, but is manifestly salt to the Taste. It does not coagulate by Heat, as the *Serum* does; but turns first thinner; and when evaporated, leaves only a thin salt Film. Different Salts have much the same Effect on it as on the other Juices of our Body; for *Acids* coagulate it, and *Alkalies* attenuate it. The Quantity of this *Mucilage* constantly supplied must be very considerable, since we see what a plentiful trouble-

(a) Anatomy Explicat. tab. 79. litt. E, E,

(b) Adversar. 2. animad. 23.

troublesome Discharge of *Synovia* follows a Wound or Ulcer of any Joint, of which Liquor the Mucilage is a considerable Part.

The Vessels which supply Liquors *Vessels.* for making the Secretion of this Mucilage are to be seen without any Preparation, but after a tolerable Injection of the Arteries the Glands are covered with them.

In a sound State we are not conscious of any Sensibility in those Glands, *Nerves.* but in some Cases which I have seen, when they inflame and suppurate, the most racking Pain is felt in them: A melancholly tho' a sure Proof of their Nerves.

These mucaginous Glands are commonly lodged in a cellular *Cellular* Substance; which is also to be observed in other Parts of the Bag formed by the Ligaments of the Articulation, and contains a fatty Matter, that must necessarily be attenuated, and forced through the including Membranes into the Cavity of the Joint, by the Pressure which it suffers from the moving Bones. *fatty Substance.*

If then the Oil is conveyed from this *Uss.* cellular Substance, and if the attenuated Marrow passes from the *Cancelli* of the Bones by the large Pores near their Extremities or in their Cavities, and sweats through the Cartilages there into the Articulations; which it may, when assisted by the constant Heat and Action of the Body, more easily do, than when it escapes through the Compact Substance of the Bones in a Skeleton: If, I say, this Oil is sent to a Joint, and is incorporated with the Mucilage, and with the fine Lymph

Lymph that is constantly ouzing out at the small Arteries distributed to the Ligaments, one of the fittest *Liniments* imaginable must be produced; for the *Mucus* diluted by the Lymph contributes greatly to its Lubricity, and the Oil preserves it from hardning. How well such a Mixture serves the Purpose it is designed for, *Boyle (a)* tells us he experienced in working his Air-pump; for the Sucker could be moved with much less Force after being moistned with Water and Oil, than when he used either one or other of these Liquors: And I believe every one at first View will allow the diluted Mucilage to be much preferable to simple Water. This *Synovia*, as this Liquor composed of Oil and Mucilage is commonly called, will therefore, while in a sound State, effectually preserve all the Parts concerned in the Articulations soft and flexible, and will make them slide easily on each other, by which their mutual Detrition and Overheating may be prevented; in the Manner daily practised in Coach and Cart Wheels, by besmearing them with Grease and Tar. After this Liquor of the Articulations becomes too thin and unserviceable, by being constantly pounded and rubbed between the moving Bones, it is reassumed into the Mass of Blood by the proper absorbent Vessels, which the Articulations have in common with all the other Cavities of the Body.

When the *Synovia* is not rubbed betwixt the Bones, it inspissates; and sometimes when the Head of a Bone

Diseases.

has

(a) Physico-mechanic. Experiments.

has been long out of its Cavity, this Liquor fills up the Place of the Bone, and hinders its Reduction; or if a Joint continues long unmoved, the *Synovia* cements the Bones, and occasions a true *Anchylosis*. *Ambrose Parè* (a) says, he has frequently seen such Cases, and *Hildanus* (b) gives a particular Example of it. If the *Synovia* becomes too acrid, it erodes the Cartilages and Bones; as frequently happens to those who labour under the *Lues Venerea*, *Scurvy*, *Scrophulæ* or *Spina ventosa*. If this Liquor is separated in too small a Quantity, the Joint, as *Galen* (c) remarks, becomes stiff; and when with Difficulty it is moved, a crackling Noise is heard, as People advanced in Years frequently experience. This Sort of Disease *Aquapendente* (d) very accurately describes, and rationally accounts for. If the Mucilage and Lymph are deposited in too great a Quantity, and the absorbent Vessels do not their Office sufficiently, they may occasion a Dropsy of the Joints, which *Hildanus* (e) has at large treated of. From this same Cause also the Ligaments are often so much relaxed, as to make the Conjunction of the Bones very weak: Thence arise the Luxations from an internal Cause, which are easily reduced, but difficultly cured; and frequently when such a superfluous Quantity of this Liquor is pent up, it becomes very acrid, and occasions a great Train

(a) Chirurgie, livre 15. chap. 18.

(b) Observat. cent. 3. obs. 77.

(c) De usu Part. lib. 12. cap. 2.

(d) De articul. part. utilitat. pars 3.

(e) De Ichore & Meliceria acri Celsi.

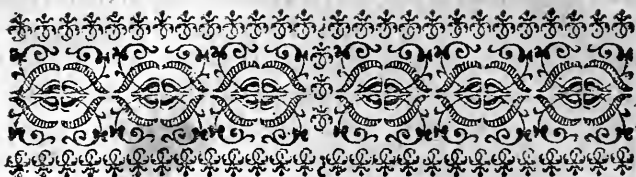
Train of bad Symptoms ; such as, Swelling and Pain of the Joints, long sinuous Ulcers and *Fistulae*, rotten Bones, Immobility of the Joints, *Marcor* and *Atrophia* of the whole Body, hectic Fevers, &c. Most of these Symptoms from the diseased *Mucus* of the Joints *Hippocrates* (a) very accurately describes, and *Hildanus* (b) gives the Histories of a great many People labouring under them.

F

T H E

(a) De locis in homine & de articul.

(b) De Ichore & Meliceria acri Celli.



T H E
A N A T O M Y
O F T H E
Human Bones.

P A R T II.

Of the Skeleton.

SKELE-
TON.



ALL the Bones of an Animal, freed from the Teguments, Muscles, Vessels, Glands and *Viscera*, and orderly connected, have the general Designation *Skeleton* *. This Term might indeed be applied to any dry Preparation, but is now by the common Consent of Anatomists restricted to this Preparation of the Bones.

Of

* *Cadaveris crates.*

Of these *Skeletons* there are two Sorts; one natural, when the Bones are kept together by their own Ligaments; the other artificial, when they are joined with Wire, or any other Substance which is not Part of the Creature to which the Bones belonged. Small Subjects, and such whose Bones are not fully ossified, are commonly prepared the first Way; because were all their Parts divided, the nicest Artist could not rejoin them, by reason of their Smallness, and of the Separation of the unossified Parts; whereas the Bones of large adult Animals are soonest and most conveniently cleaned when single, and there is no great Difficulty in restoring them to, and keeping them firm in their former natural Situation.

Sometimes we prepare the Skeletons of the same Animal in both these Ways, that is, we leave the smaller Bones joined by their natural Ligaments, and separate the larger ones till they are cleaned, when they are again connected by Wires or some such Substances.

Before we proceed to the Division and particular Description of the Skeleton, 'tis worth while to remark, that when the Bones are brought to the natural Situation, scarce any one of them is so placed as to be in a perpendicular Bearing to another; tho' the Fabrick composed of them is so contrived, that in an erect Posture, a perpendicular Line from their common Center of Gravity falls in the Middle of their common Base. By this Contrivance we can support ourselves as firmly, as if the Axis of all the Bones had been a straight Line perpendicular to the Horizon; and we

have at the same time a much greater Facility and Strength in several of the most necessary Motions we perform. It is true indeed, that wherever the Bones, on which any Part of our Body is sustained, decline from a straight Line, the Force required in the Muscles to counteract the Gravity of that Part is greater than otherwise it needed to have been; but then this is effectually provided for in such Places by the Number and Strength of the Muscles. As long therefore as we remain in the same Posture, a considerable Number of Muscles must be in a constant State of Contraction; which we know, both from Reason and Experience, must soon create an uneasy Sensation. This we call being weary of one Posture: An Inconvenience that we would not have had in standing erect, if the Bearing of all the Bones to each other had been perpendicular; but is sufficiently compensated by the Quickness, Ease and Strength of a great Variety of other Motions, as was above hinted.

The human Skeleton is generally *Divided.* divided into the *Head, Trunk, superior and inferior Extremities.*

Of the Head.

HEAD. BY the *HEAD* is meant all that spheroidal Part which is placed above the first *Vertebra* of the Neck. It therefore comprehends the *Cranium* and Bones of the *Face.*

The

The *Cranium**, Helmet or Brain-case, as the Word imports, consists of several Pieces; which joined, form a vaulted Cavity for lodging and defending the Brain, *Cerebellum*, Membranes and Vessels. CRANIUM.

The Cavity of the *Cranium* is proportioned to its Contents. Hence such a Variety of its Size is observed in different Subjects; and hence the Fore-part of the Scull, in which the anterior Lobes of the Brain are lodged, is neither so broad nor so deep as the posterior Part, where the large posterior Lobes of the Brain and the whole *Cerebellum* are contained. Cavity.

The roundish Figure of the Scull, which makes it more capacious and better able to defend its Contents from external Injuries, is chiefly owing to the equal Pressure of these contained Parts, as they grow and increase before it is entirely ossified. It is to be observed however, that in Adults the Sides of the *Cranium* are depressed below a spherical Surface by the strong temporal Muscles, whose Action hinders here the uniform Protrusion of the Bones, which is more equally performed in other Parts, where no such large Muscles are to be found. In Children, whose Muscles have not acted much, and consequently have not had great Effects on the Bones, this Depression is not so remarkable; and therefore their Heads are rounder than in Adults. These natural Causes differently disposed

F. 3.

* Κόγχη, κότθ, κώδεα, σκαφίον, calva, calvaria, cerebri galea, theca & olla capitis, testa capitis, scutella capitis.

posed in different People, may and do produce a great Variety in the Shapes of Skulls, which is still increased by the different Management of the Heads of Children when very young: So that one may, with *Vesalius* (a), know a *Turk's* Skull by its globular Figure, a *German's* by its Breadth and Flatness of the *Occiput*, *Dutch* and *English* by their oblong Shapes, &c. Two Advantages are procured from this Flatness of the Sides of the *Cranium*, viz. the Enlargement of our Sphere of Vision, and more advantageous Situation of our Ears, for receiving a greater Quantity of Sound, and for being less exposed to Injuries.

Surfaces. The superior external Surface of the *Cranium* is very smooth and equal, being only covered with the *Periosteum*, (common to all the Bones, but in the Skull distinguished by the Name of *Pericranium*,) the thin *frontal* and *occipital* Muscles, their tendinous *Aponeurosis*, and with the common Teguments of the Body; while the inferior external Surface is all over full of Risings, Depressions and Holes, which afford a convenient Origin and Insertion to the Muscles that are connected to it; and allow a safe Passage for the Vessels that run through and near it.

Internal. The internal superior Part of the Skull is commonly smooth, except where the Vessels of the *dura Mater* have made Furrows into it while the Bones were soft. These Furrows should make Surgeons cautious when they trepan here, lest in sawing

(a) Lib. i. cap. 5.

sawing or raising the Bone where such Furrows are, they wound the Vessels of the *dura Mater*. In the superior internal Surface of several Skulls there are likewise Pits, of different Magnitudes and Figures, which seem to be formed by some Parts of the Brain more luxuriant and prominent than others. Where these Pits are, the Skull is so much thinner than any where else, that it is often rendred diaphanous; the two Tables being closely compacted without a *Diploe*; the Want of which is supplied by Vessels going from the *dura Mater* into a great many small Holes observable in the Pits. These Vessels are larger and much more conspicuous than any others that every where are sent from the *dura Mater* to the Skull, as evidently appears from the large Drops of Blood they pour out when the Skull is raised from the *dura Mater* in a recent Subject; and therefore they may afford a sufficient Quantity of necessary Liquors, to prevent the Brittleness of this thin Part. The Knowledge of these Pits should be a Caveat for Surgeons, who in the Operation of the Trepan, hurry on till they have pierced the first Table; since in a Patient whose *Cranium* is thus pitted, the *dura Mater* and Brain may be destroyed before the Instrument has pierced near the ordinary Thickness of the Skull. The internal Base of the Skull is extremely unequal, for lodging the several Parts and *Appendices* of the Brain and *Cerebellum*, and allowing a Passage and Defence to the Vessels and Nerves that go into or come out from these Parts.

The Bones of the *Cranium* are com- Tables.
posed of two bony Tables, and an in-
intermediate

intermediate cellular Substance, commonly called their *Diploe* *. The external Table is thickest; the inner, from its Thinness, and consequent Brittleness, has got the Name of *Vitrea*. Whence we may know the Reason of such mischievous Consequences so often attending a Collection of Matter in the *Diploe*, either from an external or internal Cause, before any Sign of such a Collection appears in the Teguments that cover the Part of the Scull where it is lodged.

The *Diploe* has much the same Texture with the *Cancelli* of other Bones, and contains Marrow, which having numerous Branches of Vessels spread on its Membranes, seems bloody. These *Cancelli*, with their Marrow, serve the same Uses here as they do in other Bones. I have found the *Diploe* in several old Subjects so obliterated, that scarce any Vestige of it was to be seen; neither is it observable in some of the hard craggy Bones at the Base of the Scull. Hence another useful Caution to Surgeons, who trust to the Bleeding, Want of Resistance, and Change of Sound, as certain Marks in the Operation of the Trepan, for knowing when their Instrument has sawed through the first Table, and reached the *Diploe*.

The *Cranium* consists of eight *Divided*. Bones, six of which are said to be proper, and the other two are reckoned common to it and the Face. The six proper are the *Os frontis*, two *Ossa parietalia*, *Bones*. two *Ossa temporum* and the *Os occipitis*.
The

* Medullium, commissura,

The common are the *Os Ethmoides* and *Sphenoides*.

The *Os frontis* forms the whole anterior Part of the Vault, the two *parietalia* form the superior and lateral Part, the *Ossa temporum* compose the inferior Part of the Sides, the *Os occipitis* the whole posterior Part and some of the Base, *Os Ethmoides* is placed in the anterior Part of the Base, and the *Sphenoides* in the Middle of it.

These Bones are joined to each other by five *Sutures*; the Names of *Sutures*, which are the *Coronal*, *Lambdoid*, *Proper. Sagittal*, and two *Squamous*.

The *Coronal* * runs upward, across and over the Head, from within an *Coronal*. Inch or so of the external *Canthus* of one Eye, to the like Distance from the other, which is much the same Place where the *Romans* wore their *Vittæ*, *Coronæ*, or Garlands; whence this Suture has got its Name. 'Tis to be remarked, That for an Inch or more, at the inferior Part of this Suture on each Side, the Indentations which are so evident thro' the rest of it, are not observable; but this Articulation becomes plainly squamous and very smooth, by the parietal mounting on the frontal Bone, and by the two being accurately applied to each other. This we may believe proceeds from the Action of the temporal Muscles, because Bones are also smooth elsewhere, when Bellies of Muscles cover them. The Muscles, by this Mechanism, are less exposed

* Στεφανία, Arcualis, Puppis.

posed to any Harm from sharp Points or unequal Surfaces of the Bones.

The *Lambdoidal* * *Suture*, begins *Lambdoid.* some way below, and farther back than the *Vertex* or Crown of the Head, whence its two Legs are stretched obliquely down and to each Side, in Form of the *Greek* Letter Λ , and are now generally said to extend themselves to the *Base* of the Skull; but the old Anatomists reckoned the proper *Lambdoid* Suture to terminate at the *Squamous* Sutures, and what is extended at an Angle down from that, they called *Additamentum suture Lambdoidis* †.

This *Suture* is often very irregular, seeming to be made up of a great many small Sutures, which surround so many little Bones, that are generally larger and more conspicuous on the external Surface of the Skull, than internally. These had the Name of *Triquetra* bestowed on them by their first Discoverers, who it seems found some of them approaching to a triangular Figure, but for the most Part, they are far from such a Shape. They are also called *Wormiana*, from *Olaus Wormius* the Dane, who, besides the larger ones reckoned Specificks in the Epilepsy, demonstrated (a) several small Bones of this Kind, that were generally overlooked by his Contemporaries, but seem to be both described and painted by many Authors who wrote before him. The Formation of the

* *Laudæ, Proræ, Hypsiloïdes.*

† *Lambdoides harmonialis, Lambdoides inferior, Occipitis Cornua.*

(a) *Museum lib. 3. cap. 26.*

the *Ossa Triquetra*, is owing to the Bones betwixt which they are found, becoming too solid before their bony Fibres meet, and therefore not being capable to be stretched so far as they ought, for then the middle Space which remains unossified, begins to assume a bony Nature at several distinct Points that gradually enlarge, and at last, each of these bony Pieces is indented into the larger Bones and into each other. Probably those Children, who have a large opening in this Place at their Birth, will have the largest *Ossa Triquetra*. To confirm this Account I have given of the Formation of these little Bones, we may remark, that such Bones are sometimes seen in other Sutures as well as in the *Lambdoid*. *Vesalius* (a) paints one at the Meeting of the *squamous* and *sphenoid* Sutures; *Paaw* (b) tells us he saw that Part of the *parietal* and *frontal* Bones, where the *Fontanelle* is in Children, surrounded with a Suture; *Ruyssch* (c) relates four Examples of such Bones in the *Sutura Squamosa*, three in the *Coronal*, and two between the *Os Frontis* and *Sphenoides*; some such Examples are also related by *Bartholin* (d); and I have seen separate distinct Bones at the Conjunction of the *Ethmoid* and *Sphenoid*, of the *sphenoid* and *parietal* Bones, and in the *Coronal* Suture.

The *Sagittal* Suture *, runs exactly in the middle of the superior Part of the Scull, and for the most Part, terminates

(a) Lib. 1. cap. 6. fig. 4.

(b) In Hippocrat. de Capit. vuln.

(c) Musæum Anat.

(d) Hist. anat. Cent. 1. hist. 51.

* Παρσδοειδης, ὑβριαια, ἐπιζευγνῦσα, Instar virgæ, neivalis,

minates at the middle of the *Coronal* and of the *Lambdoid* Sutures, between which it seems placed as an Arrow is, when fully drawn, between the String and Bow: However this Suture is frequently continued through the Middle of the *Os Frontis*, down to the Root of the Nose; and according to *Riolan* (a) this oftner happens in Women than Men, but is said by *Vesalius* (b) to be met with more frequently in Male Skulls than in Female: Each have their Partizans, and probably those Authors, who have not blindly followed the Authority of former Writers, have given their Opinion according to the Difference in the Skulls examined by them. Among the Skulls which I have seen thus divided, the Female are the most numerous. *Vesalius* (c), *Paaw* (d), and *Laurent* (e) have delineated and described the *Sagittal* Suture sometimes dividing the *occipital* Bone as far down as the great Hole through which the *Medulla spinalis* passes; this I never saw, nor such a double sagittal Suture as *Eustachius* (f) mentions.

In some old Skulls which are in my Possession, scarce a Vestige of any of these three Sutures already described, is to be seen. In other Heads, one or two of the Sutures only disappear; but I never could discover any
Rea-

nervalis, instar teli, instar veru, secundum capitis longitudinem prorepens, conjungens, columnalis, recta, acualis.

(a) Anat. Sect. 2. cap. 19.

(b) Lib. 1. cap. 6. & in Epitome.

(c) Lib. 1. cap. 5. fig. 3. 4. & in text. cap. 6.

(d) In Cels. de re medic. cap. 1.

(e) Hist. anat. lib. 2. cap. 16.

(f) Ossium examen.

Reason for thinking them disposed in such different Manners in Skulls of different Shapes as *Hippocrates* (a) and *Galen* (b) alledge they are.

The *Squamous Agglutinations* or *False Sutures* * are one of each Side, *Squamous*, a little above the Ear, of a semicircular Figure, formed by the overloping (like one Scale upon another) of the superior Part of the *temporal* Bones on the inferior Part of the *parietal*, where there are in both Bones, a great many very small Risings and Furrows, which are indented into each other, tho' these Inequalities do not appear till the Bones are separated. In some few Skulls indeed, *Columbus* (c) and *Dionis* (d) have justly remarked the Indentations here to be as conspicuous externally as in other Sutures; and what is commonly called the posterior Part of this squamous Suture, always has the evident serrated Form, and therefore is reckoned by some a distinct Suture, under the Name of *Additamentum posterius suturæ squamosæ*.

We ought here to remark with *Vesalius* (e) and *Winslow* (f), that the true squamous Sort of Suture is made use of, to join all the Edges of the Bones on which the temporal Muscles are placed, and is not confined to the Conjunction

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ction

(a) De vulner. Capitis.

(b) De ossib. cap. 1. & de usu Part. lib. 9. cap. 17.

* Ασπίδοειδῆ περισκολιύματα, κρατάρια, Temporales, Corticales, Mendosæ, Harmoniales, Commissuræ in unguem.

(c) De re Anat. lib. 1. cap. 4.

(d) Anatomie 3. Demonstr. des Os.

(e) Anat. lib. 1. cap. 6.

(f) Memoires de l'Acad. des Sciences 1720.

tion of the temporal and parietal Bones: For the two Parts of the sphenoidal Suture which are continued from the anterior Extremity of the common squamous Suture just now described; of which one runs perpendicularly down, and the other horizontally forwards; and also the lower Part of the coronal Suture already taken Notice of, may all be justly said to pertain to the squamous Suture. The Manner how I imagine this Sort of Suture is formed at these Places is, That by the Action of the strong temporal Muscles on one Side, and by the Pressure of the Brain on the other, the Bones are made so thin as to allow no other Suture; and then the *squamous* Form is more convenient here, because such thin Edges of Bones being accurately applied one to another, have scarce any rough Surface, to hinder or hurt the Muscle in its Contraction; which is still further provided for, by the Manner of laying these Edges on each other; for in viewing them externally, we see the temporal Bones covering the sphenoidal and parietal, and this last supports the sphenoidal, while both mount on the frontal; from which Disposition of the Edges of the Bones, it is evident, that when the temporal Muscle is contracting, which is the only Time it presses strongly in its Motion on the Bones, its Fibres slide over the external Edges smoothly. Another Advantage still in this Mechanism is, that all this bony Part is made stronger by the Bones thus supporting each other.

The Bones of the Scull are joined
Common to one another, and to those of the
Sutures. Face, by the Means of these other
 five

five Sutures, *Ethmoidal*, *Sphenoidal*, *Transverse*, and two *Zygomatic*.

The *Ethmoidal* and *Sphenoidal* surround the Bones of these Names; *Ethmoidal*, and in some Places help to make up *Sphenoidal*, other Sutures, particularly the *Squamous* and *Transverse*; and in other Parts, there is but one Suture common to these two Bones.

The *Transverse* Suture runs quite cross the Face, from the external *Transverse*. *Canthus* of one Orbit to the same Place of the other, by sinking from the *Canthus* down the outside of the Orbit to its Bottom; then mounting upon the Inside, it is continued by the Root of the Nose down the internal Part of the other Orbit, and up again to the other *Canthus*. It might be here remarked, that there are some Interruptions of this Suture in this Course I have described, by the Bones not being joined every where, but being separated, to leave Holes which are afterwards to be mentioned.

The *Zygomatic* Sutures are one of each Side, being short and stretched *Zygomatick*, from above, obliquely downwards and backwards, to join the posterior Process of the Cheek-bone to the Process of the *Os temporum*, which advances towards the Face; so that the two Processes thus united, form a Sort of Bridge, not unlike the *Jugum* of the Ancients, under which the *temporal* Muscle passes.

It must be here observed, that the Indentations of the *Sutures* do not appear any where on the Inside of the *Cranium*, near so strong as on the Outside, but the Bones seem almost

conjoined in a straight Line; nay in some Skulls, the internal Surface is found entire, while the Sutures are manifest without. *Winflow* (a) proves, that by this Mechanism, there is no Risk of the sharp Points of the Bones growing inwards, since the external *Serræ* of each of the conjoined Bones, rest upon the internal smooth-edg'd Table of the other Bone; and the Bones will hence better resist any external Force at these Parts, because the Sutures cannot yield, unless the serrated Edges of the one Bone, and the plain internal Plate of the other are both broke.

The Manner how these Sutures are formed; was explained in the general History of the Bones.

The Advantages of the Sutures of the *us. Cranium* are these. 1. That this *Capsula* is more easily formed and extended into a spherical Figure, than if it had been one continued Bone. 2. That in the Birth, as the Bones are at some Distance from each other, they might, by yielding, allow to the Head a Change of Shape, accommodated to the Passage it is engaged in. Whence in hard Labour of Child-bed, the Bones of the *Cranium*, instead of being only brought contiguous, are sometimes made to mount one on the other: A remarkable Instance of this Kind I had Occasion to see in an Infant, one of whose *Ossa parietalia* overlapped the other, and both were riding on the *Os occipitis*, which occasioned a redness and swelling in all the external Parts of the Head, accompanied with either a constant

(a) Memoires de l' Acad. des Sciences, 1720,

stant crying and tossing, or drowsy dosing and Insensibility. These Symptoms went off in a few Hours after I had reduced the Bones to their natural Place. 3. With a view to the Sutures allowing some Transpiration of Steams from the Brain, which was the old Doctrine; or some Communication of the Vessels without and of those within the Scull; larger here than in any other Part of the *Cranium*, according to some Moderns, Physicians continue to order *Cucuphæ*, *Fomentations*, *Cataplasms*, *cephalick Plaisters*, *Blisters* to be applied, and *Issues* to be eroded or cut in the Head, at those Places where the Sutures are longest in forming, and where the Connection of the Bones is afterwards loosest for the Cure of a *Phrenitis*, *Mania*, *inveterate Head-ach*, *Epilepsy*, *Apoplexy*, and other Diseases of the Head. This Doctrine of Transpiration or Communication of Vessels at the Sutures has occasioned strong Disputes. If some Observators have not been so far byassed in its Favour, as to impose their Opinion instead of Facts, there would appear to be some Ground for this Doctrine. *Columbus* (a) *Verduc* (b) and *Dionis* (c) relate Observations of Persons whose Sutures were too closely united, and who had been subject to Head-aches, which at last were mortal. A fourth Use of the Sutures is, that the *dura Mater* may be more firmly suspended by its Processes which innuate themselves into this Conjunction of the

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Bones;

(a) De re Anat. lib. i. cap. 5.

(b) Nouvelle Osteologie chap. 14.

(c) Anatomie 3. demonstr. des Os.

Bones; for doing this more equally, and where the greatest Necessity of Adhesion is, the Sutures are disposed at pretty equal Distances, and the large *Reservoirs* of Blood the *Sinuses* are immediately under or near them. 5. That by this Contrivance, Fractures might be prevented from reaching so far as otherwise they would. 6. The Separation of the Bones, by the Sutures yielding, has evidently afforded great Relief in some Diseases (a), and possibly in others may have prevented the very ill Consequences which might have been expected from such a Force pushing the Brain from within outwards as could force the Bones asunder, tho' in most of them this Separation of the Sutures was blamed for the violent Pain which the Patients suffered (b).

After considering thus the general Structure of the *Cranium*, I now proceed to examine more particularly the several Bones of which that Brain-case consists: The first mentioned in the Enumeration of them was the

OS FRONTIS *; so named, because it is the only Bone of that Part of the Face we call the *Fore-head*, tho' it reaches a good deal further. It has much the same Shape with the Shell

(a) Ephemerid. Germanic. Dec. 1. Ann. 4 & 5. Observ. 33.

(b) Ibid. Dec. 2. Ann. 9. Observ. 230. Ibid. Cent. 10. Obs. 31. Vander Linden Medicin. Physiolog. Cap. 8. Art. 4. § 16. Hildan. Observ. Cent. 1. Obs. 1. Pechlin. Observ. L b. 2. Observ. 40.

* Μετώπια, βέγγυα, Coronale, Inverecundum, Puppis, sensus communis, quibusdam Sincipitis,

Shell of the *Concha bivalvis*, commonly called the Cockle; for the greatest Part of it is convex externally, and concave internally, with a serrated circular Edge, while the smaller Part, by reason of its Processes and Depressions, has no regular Figure.

The external Surface of the *Os* External
Surface. *frontis* is perfectly smooth at its upper convex Part; but several Processes Processes. and Cavities are observable below: For at each Angle of each Orbit, the Bone jets out to form four Processes, two internal, and as many external, which from this Situation, may well enough be named *angular*. Between the internal and external angular Processes of each Side, an arched Ridge is extended, on which the Eye-brows are placed. And very little above the internal Extremity of these *superciliary* Ridges, a Protuberance may be remarked in most Skulls, where the Bone is protruded to make Place for two large Cavities, of which hereafter. Betwixt the internal angular Processes, a small Process rises, which forms some Share of the Nose, and thence is named *Nasal*. Some observe a protuberant Part on the Edge of the Bone behind each external angular Process, which they call *temporal* Processes; but these are inconsiderable. From the Under-part of the *superciliary* Ridges, the frontal Bone runs a great Way backwards, which Parts may justly enough be called *Orbital* Processes. These are, contrary to the rest of this Bone, externally concave for receiving the Globes of the Eyes with their Muscles and Fat.

In each of the *orbital* Processes behind the Middle of the superciliary Ridges, a considerable Sinuosity is observed, where the *Glandula innominata Galeni* or *lacrymalis* is lodged; and behind the internal angular Processes, a small Pit may be remarked, where the Cartilaginous Pally of the *Musculus obliquus major* is fixed. Betwixt these two orbital Processes, a large Discontinuation of the Bone is to be seen, into which the cribriform Part of the *Os Ethmoides* is incased; the frontal Bone frequently has little Caverns formed into it here where it is joined to the Ethmoid Bone. Behind the external angular Processes, the Surface of the Frontal Bone is considerably depressed, where Part of the *temporal* Muscle is placed.

The *Foramina*, or Holes, observable on the external Surface of the frontal Bone, are three of each Side; one in each superciliary Ridge, a little removed from its Middle towards the Nose. Thro' this Hole a Twig of the *Optalmick* Branch of the fifth Pair of Nerves passes out of the Orbit, with a small Artery from the Carotid, to be distributed to the Teguments and Muscles of the Forehead. These Vessels in some Skulls make Furrows in the *Os frontis*, especially in the Bones of Children, as *Ruysch* (a) has also well observed of another considerable Vessel of this Bone near its Middle; and therefore, we ought in such to beware of transverse Incisions on either Side of the *Os frontis*, which might open these Vessels, while they

(a) Mus. Anat. Theca D. Reposit. 4, N.º, 3.

they are yet in Part lurking within the Bone; for in such a Case, 'tis difficult to stop an Hemorrhagy, because the Adhesion of the Artery to the Bone, hinders its Contraction, and consequently Stypticks can have little Effect; the Sides of the Furrow keep off compressing Substances from the Artery, and we would wish to shun Cauteries or Escharoticks, because they make the Bone carious. But to return to the *superciliary Foramina*, we must remark, that often instead of a Hole, a Notch only is to be seen: Nay, in some Skulls, scarce a Vestige even of this is left; in others both Hole and Notch are observable, and that when the Nerve and Artery run separately. Frequently a Hole is found on one Side, and a Nich on the other; at other Times we see two Holes; or there is a common Hole without, and two distinct Entries internally. Near the Middle of the internal Side of each Orbit, hard by, or in the *Sutura transversalis*, there is a small Hole left for the Passage of the nasal Twig of the first Branch of the fifth Pair of Nerves. This Hole is sometimes intirely formed in the *Os frontis*; otherwhiles, the Sides of it are composed of this last Bone and of the *Os planum*. 'Tis commonly known by the Name of *Orbiter internus*, tho' *anterior* should be added, because of the next, which is commonly omitted. This, which I call *Orbiter internus posterior*, is such another as the former, only smaller, and an Inch or so deeper in the Orbit: Through it a small Artery sent from the internal *Carotid*, before it pierces the *dura Mater*, passes to the Noife. Besides these six, there are a great Number of small Holes observable

servable on the external Surface of this Bone, particularly in the two Protuberances above the Eye-brows, under which the *Sinuses* are. Most of these penetrate no further than the *Sinuses* or *Diploe*, if the *Sinuses* are wanting; tho' sometimes I have seen this Bone so perforated by a vast Number of these small Holes, that when looked at between ones Eye and a clear Light, it appeared like a Sieve; and in the Orbit of the Generality of *Skeletons*, we may observe one, two, or more Holes, which allow a Passage to a Hog's Bristle through the Skull. The Place, Magnitude or Number of these however is uncertain: They generally serve for the Transmission of small Arteries or Nerves.

The *Os frontis* is internally concave, except at the orbital Processes, which are convex internally to support the anterior Lobes of the Brain. The internal Surface of this Bone is not so smooth as the external; for in the lateral and posterior Parts, the larger Branches of the Arteries of the *dura Mater* make some Furrows. The Sinuosities from the luxuriant Risings of the Brain, mentioned when describing the general Structure of the *Cranium*, are often very observable on the superior Part of this internal Surface; and its anterior and inferior Parts are marked with the Contorsions of the anterior Lobes of the Brain. Through the Middle of this internal Surface, where always in Children, and frequently in old People the Bone is divided, either a Ridge stands out, to which the Superior Edge of the *Falx* is fastned, or a Furrow runs, in which the upper Side of the

the superior longitudinal *Sinus* is lodged; on both these Accounts chirurgical Authors justly discharge the Application of the Trepan here. The Reason of this Difference in Skulls is alledged by some Authors to be this, That in thin Skulls the Ridge strengthens the Bones, and in thick ones there is no occasion for it. To this way of accounting for this Phænomenon, it may justly be objected, that generally very thick Skulls have a large Spine here, and frequently thin ones have only a Furrow. Perhaps this Variety may be owing to the different Times of a complete Ossification of these Parts in different Subjects: For if the two Sides of this Bone meet before they arrive at their utmost Extent of Growth, they will unite very firmly, and all their Fibres endeavour to stretch themselves out where the least Resistance is, that is, between the Hemispheres of the Brain. To support this Reasoning we may remark, that those Adults, whose frontal Bone is divided by the sagittal Suture, never have a Ridge in this Place.

Immediately at the Root of this Ridge or Furrow there is a small *Foramen*. Hole, which sometimes pierces through the first Table, otherwhiles opens into the superior *Sinus* of the *Ethmoid* Bone within the Nose. In it a little Process of the *Falx* is lodged, and a small Artery, and sometimes a Vein runs, as *Morgagni* (a) has taken notice; and the superior longitudinal *Sinus* begins

(a) *Adversar.* 6. *animad.* 31.

gins here. This Hole however is often not entirely proper to the *Os frontis*; for in several Skulls I observe, with *Ingraffias* (a), the inferior Part of it formed in the superior Part of the Base of the *Crista Galli*, which is a Process of the *Os Ethmoides*.

The *Os frontis* is composed of two *Substance*. Tables and an intermediate *Diploe*, as the other Bones of the *Cranium* are, and in a middle Degree of Thickness between the *Os occipitis* and *parietalia*, is pretty equally dense all through, except at the orbital Processes, where, by the Action of the Eye on one Side, and Pressure of the Lobes of the Brain on the other, it is made extremely thin and diaphanous, and the *Meditullium* is entirely obliterated. Since in this Place there is so weak a Defence for the Brain, it may be a Reason why Fencers justly esteem a Push in the Eye so mortal (b).

The *Diploe* is also exhausted in that *Sinus*. Part above the Eye-brows where the two Tables of the Bone separate, by the external being protruded outwards, to form two large Cavities, which obtain the Appellation of *Sinus frontales*. These are divided by a middle perpendicular bony Partition. Their Capacities in the same Subject are seldom equal, tho' it is hard to determine, whether the Right or Left is most frequently largest: And in different Bones their Size is as inconstant; nay I have examined some, where they were entirely wanting, which oftner happens in such
as

(a) Comment. in Galen. de Ossib. cap. 1. comment. 2.

(b) Ruysch Observ. Anat. Chir. Observ. 54.

as have a flat Fore-head, and whose sagittal Suture is continued down to the Nose, than in others, as *Fallopius* (a) has remarked; and in Children they are never seen. In some Skulls, besides the large osseous *Septum*, there are found in each *Sinus* several bony Pillars, or short Partitions; in others these are wanting. For the most part the middle *Septum* is entire; other times it is discontinued, and the two *Sinuses* communicate. When the *Sinuses* are seen in such Skulls as have the frontal Bone divided by the sagittal Suture, the Partition dividing these Cavities is evidently composed of two Plates, which easily separate. Each *Sinus* commonly opens by a roundish small Hole, at the internal and inferior Part of the internal angular Processes, into a *Sinus* formed in the Nose at the superior and posterior Part of the *Os unguis*; near to which there are also some other small *Sinuses* of this same Bone, observed by Mr. *Cowper* (b), the greater Part of which open separately nearer the *Septum narium*, and often they terminate in the same common Channel with the large ones.

In a natural sound State these Cavities are of considerable Advantage; for the *Uses* Organ of Smelling being thus enlarged, the *Effluvia* of odorous Bodies will more difficultly escape it: Then, these and the other Cavities which open into the Nose, increase the Sound of our Voice, and render it more melodious, by serving as so many Vaults to

H

re-

(a) *Exposit. de Ossibus*, cap. 13.

(b) *Drake's Anthropolog.* Book 3. Chap. 10.

resound the Notes. Hence People labouring under a *Coryza*, or stopping of the Nose from any other Cause, when they are by the Vulgar, tho' falsely, said to speak through their Nose, have such a disagreeable harsh Voice.

From the Description of these *Sinuses*, 'tis evident how useless, nay how pernicious it must be, to apply a Trepan on this Part of the Scull: For the Trepan, instead of piercing into the Cavity of the *Cranium*, would reach no further than the *Sinuses*; or if it was pushed on through the inner Table, any extravasated Blood that happened to be within the Scull would not be discharged outwardly, but would fall into the *Sinuses*, there to stagnate, corrupt and stimulate the sensible Membranes, from which also there would be such a constant drilling of a glairy Mucus as would retard if not hinder a Cure, and wou'd make the Sore degenerate into an incurable *Fistula*. Besides, as it would be almost impossible in this Case to prevent the Air passing thro' the Nose from having constant Access to the *dura Mater* or Brain, such a Corruption would be brought on these Parts as wou'd be attended with great Danger. Further, in Respiration the Air rushing violently into these Cavities of the *Os frontis*, and passing thro' the external Orifice whenever it was not well covered and defended (as *Paaw* (a) and *Palsyne* (b) tell us it did in their Patients) would not only prevent the closing up of the external Orifice, but might other-

(a) De Offibus Pars. 1. Cap. 7.

(b) Anatomie chirurg. Traité 4. Chap. 15. Nouvelle Osteologie Partie 2. Chap. 3.

otherwise bring on bad Consequences. *Palafyn's* Apothecary of *Lovain* was so oppressed when ever the small external Passage into one of these *Sinuses* was left open, that he despair'd of living unless he cou'd cure it up.

The *Os frontis*, at its superior circular Part, is joined from one Tem- Connexion ple to the other, by the coronal Suture, to the *Ossa parietalia*; from the Termination of the coronal Suture to the external angular Processes, the *sphenoidal* Suture connects it to the Wedge-like Bone; at the external *Cantbi* of the Eyes, its angular Processes are joined by the transverse Suture to the *Ossa malarum*, to which it adheres one third down the external Part of the Orbits; whence to the Bottom of these Cavities, and a little up on the internal Sides, these orbital Processes are connected to the *sphenodal* Bone by means of that same Suture. In some few Skulls however there appears at the superior Part of the long Slit, at the Bottom of the Orbit, a Discontinuation of these two Bones. At the internal Side of each Orbit, the orbital Process is indented between the *cribriform* Part of the *ethmoid* Bone, and the *Os planum* and *unguis*; and afterwards the transverse Suture joins this Bone to the superior nasal Processes of the *Ossa maxillaria superiora*, and to the *Ossa nasi*. And Lastly, Its nasal Process is connected to the nasal *Lamella* of the *ethmoid* Bone.

The *frontal* Bone serves to contain, defend and sustain the anterior Lobes uses. of the Brain. It forms a considerable Part of the Cavities that contain the Globes of the Eyes, helps to make up the *Septum na-*

rium, Organ of Smelling, &c. From the Description of the several Parts, the other Uses of this Bone are evident.

In a Child born to the full Time of *Infants*. the frontal Bone is divided through the Middle: The superciliary Holes are not formed; often a small round Piece of each orbitar Process, behind the superciliary Ridge, is not ossified, and there is no *Sinus* to be seen within its Substance.

OSSA PARIETALIA *. These *Ossa Pa-* two Bones have got the Name of *rietalia*. *Parietalia*, because they serve like two strong Walls to defend the *Encephalon*. They are also called *Ossa bregmatis*, because the *Fontanella*, or *Fons pulsantis* †, observable here in Children before these Bones are entirely ossified, makes this Place appear to the Touch always moist. Hence the Ancients alledged the superfluous Moisture of the Brain was evacuated this Way. Here by the way an useful Observation in Midwifery may be taken notice of, That if in time of Labour the ligamentous Membrane which covers the *Fontanelle* is firm and stretched, and the Pulsation of the Arteries is felt below it, 'tis a certain Proof the Child is alive; but if on the contrary the Membrane is shriveled and flaccid, and no Pulsation is felt, then there is Reason to think that the Child is dead: For as the Want of the Bone is only supplied by
this

* Κορυφήs, Pariē, synepitēis, verticis, arcualia, nervalia, cogitationis, ratio is, bregmatis, madefactionis.

† Palpitans vertex, foliolum, folium, triangularis lacina.

this Membrane, the Pulsation of the Vessels below is easily perceived; while the Distension of these Vessels keeps the Membrane stretched: As soon therefore as after Death these are emptied, both Pulsation and Tension disappear. When the Condition of the Child is known, the Operator can determine what the Method of treating his Patient should be. However it must be remarked, that the greatest Share of this Opening is formed in the *Os frontis*, which therefore might more justly claim the Name. The Bone is generally thinner all the Life at this Part, than any where else; but after seven Years of Age, seldom any unossified Part is left: *Baubin* (a), *Bartholin* (b) and *Diemerbroek* (c), affirm their having observed this opening in Adults, which I never saw; tho' *Kerckringius* (d) assures us it is no uncommon Case, giving for his Reason, that he had seen it in ten different People. Physicians, by prescribing Applications to this particular Part preferably to any other, in internal Diseases of the Head, seem still to believe that a Derivation of noxious Liquors from the Brain, or a more effectual Operation of Medicines applied externally, can be more easily procured this Way, than at any other Part of the *Cranium*.

Each of the *Ossa parietalia* is an irregular square Bone, the superior and anterior Sides being longer than the posterior and inferior. This last Side is a con-

H 3

Figure.
cave

(a) Theatr. Anatom. lib. 3. cap. 6.

(b) Anatom. lib. 4. cap. 6.

(c) Anatom. lib. 9. cap. 6.

(d) Osteogenea foetuum, cap. 2.

cave Semicircle, the middle Part giving way to the superior round Part of the temporal Bone, while the two Extremities are stretched out: That behind, to join the posterior thick Part of the temporal Bone, and the *Os occipitis*; and the anterior to meet the *sphenoid* Bone. This last is so large, as to have the Appearance of a Process.

The external Surface of the *Ossa*
External *parietalia* is convex, and upon it,
Surface. between the anterior and posterior
 Sides, somewhat below the middle
 Height of the Bone, there rises an arched
 Ridge, of a whiter Colour generally than any
 other Part of the Bone; from which, in Bones
 that have strong Prints of Muscles, a great
 many converging Furrows run down like so
 many *Radii* from a Circumference towards a
 Center. To the Ridge of each Bone the Origin
 of the temporal Muscle is fixed, and, by
 the Pressure of its Fibres, forms the Furrows
 just now mentioned. Below these we observe,
 near the semicircular Edges, a great many
 Risings and Depressions, which with the In-
 equalities of the temporal Bone form the squa-
 mous Suture. Near the superior Sides of these
 Bones, towards the posterior Part, is a small
 Hole in each, through which a Vein passes
 from the Teguments of the Head to the lon-
 gitudinal *Sinus*. Sometimes I have seen a
 Branch of the temporal Artery pass thro' this
 Hole, to be distributed to the superior Part of
 the *Falx*, and to the *dura Mater* at its Sides,
 where it had frequent Anastomoses, with the
 Branches of the Arteries derived from the ex-
 ternal Carotids, which commonly have the
 Name

Name of the Arteries of the *dura Mater*. In several Skulls one of the *Ossa Bregmatis* has not this Hole, and in others there are two Holes to be seen. In some Subjects this *Foramen* is wanting in both these Bones. Most frequently this Hole is through both Tables; otherwhiles the external Table is only perforated. The Knowledge of the Course of these Vessels may be of use to Surgeons, when they make any Incision near this Part of the Head, lest if the Vessels are rashly cut near the Hole, they shrink within the Substance of the Bone, and so elude both Ligature and Medicines; whence an obstinate Hæmorrhagy must follow; some Instances of which I have seen.

On the internal concave Surface of the parietal Bones we see a great many deep Furrows, disposed somewhat like the Branches of Trees: These are formed by the Pulsation of the Arteries of the *dura Mater*, while the Bones are young and soft. In some Skulls I have observed these Furrows so deep, that the Bone has sprouted out on each Side till the Sides met, and made a sort of bony Bridge over the Artery; which, as was observed in the general Description of the *Cranium*, ought to make Surgeons cautious in sawing and raising these Bones, when they perform the Operation of the Trepan. In these furrows we frequently see Passages into the *Diploe*; and sometimes I have observed Canals going off, which allowed a small Probe to pass some Inches into the bony Substance; Cowper (a) affirms his having observed these Canals

*Internal
Surface.*

(a) Anatom. Explic. of XC. Tab. Fig. 2.

Canals piercing the Bone towards the *Occiput*. On the superior internal Side of the *Ossa Bregmatis* there is a pretty large Sinuosity, frequently larger in the Bone of one Side than of the other, where the superior Part of the *Falx* is fastned, and the superior longitudinal *Sinus* is lodged. Near the inferior posterior Angle of these Bones internally is a Depression in several Sublects, formed by Part of the lateral *Sinus*: And then, in no Bones of the Scull are the Pits made by the luxuriant Parts of the Brain more frequently to be seen, or more considerable than in these parietal Bones.

The *Ossa parietalia* are among the *Substance.* thinnest Bones of the *Cranium*, but enjoy the general Structure of two Tables and *Diploe* the completest, and are the most equal and smooth.

These Bones, at their anterior *Connexion.* Edge, are joined to the *Os frontis* by the coronal Suture; at their long inferior Angles, which some reckon Processes to the *sphenoid* Bone, by Part of that Bone's Suture; at their inferior Side, to the *Ossa temporum*, by the squamous Suture and its posterior *Additamentum*; at their posterior Side, to the *Os occipitis* or *Ossa triquetra*, by the lambdoid Suture; at their superior Edge, to one another, by the sagittal Suture.

They have no particular Uses besides *Uses.* those mentioned in the Description of their several Parts, except what are included in the general Structure of the *Cranium*.

In a Child born to the full Time *of children.* none of the Sides of this Bone are com-

completed, and the Hole does not appear.

*OSSA TEMPORUM**, so named, say Authors, from the Hair's first becoming gray on the Temples, and so discovering Peoples Ages, are each of them equal and smooth above, with a very thin semicircular Edge; which, from the Manner of its Connection with the neighbouring Bones, is distinguished by the Name of *Os squamosum*. Behind this, the superior Part of the temporal Bone is thicker and more unequal, and is described by *Albinus* (a) as a distinct Part, under the Name of *Pars mamillaris*. Towards the Base of the Scull the temporal Bone appears very irregular and unequal; and this Part, instead of being broad, and placed perpendicularly, as the others are, is contracted into an oblong very hard Substance, extended horizontally forwards and inwards, which in its Progress becomes smaller, and is commonly called *Os petrosum*.

Three external Processes rising from each of the temporal Bones are generally described. The first, placed at the inferior and posterior Part of the Bone, from its Resemblance to a Nipple, is called *Mastoides* or *Mamillaris*. It is not solid, but within is composed of *Cancelli* or small Cells, which have a Communication with the large Cavity of the Ear, the Drum;

External
Surface.
Processes.

* Κρηταρῶν, κορῶν, κορῶν, λεπιδοειδῆ, πολυειδῆ, λιθοειδῆ, Temporalia, lapidosa, mendosa, dura, arcualia, tympanum, armalia, laxea, parietalia,

(a) De Ossib. § 26.

Drum; and therefore Sounds being multiplied in this vaulty Labyrinth, will be increased before they are applied to the immediate Organ of Hearing. Into the mastoid Process the *Sterno-mastoideus* Muscle is inserted; and to its posterior Part, where the Surface is rough, the *Trachelo-mastoideus* and Part of the *Splenius* are fixed. About an Inch farther forward the second Process begins to rise out from the Bone; and having its Origin continued obliquely down and forwards for some Way, it becomes smaller, and is stretched forwards to join with the *Os mala*; they together forming the bony *Jugum*, under which the temporal Muscle passes: Hence this Process has been named *Zygomatic* *. By this Process being produced in this Manner from the temporal Bone, the anterior inferior Part of its Base is an oblong distinct Tubercle, which in a recent Subject is covered with a smooth polished Cartilage, that is the same continued Substance with the Cartilage lining the Cavity immediately behind this Tubercle. From the inferior craggy Part of the *Os temporum* the third Process stands out obliquely forwards. The Shape of it is generally said to resemble the ancient *Stylus scriptorius*; and therefore it is called the *Styloid* Process †. Some Authors however contend it ought to be named *Steloid*, from its being more like to a Pillar. Several Muscles have their Origin from this Process, and borrow one half of their Name from it;

as

* Καρχήδς, Paris, ansæ ossium temporum; ossa arcualia, paria, jugalia, conjugalia.

† Γεαρσειδν, βελονσειδν, αληκτερον, Os calaminum, sagittale, clavale, acuale, calcar capitis.

as, *Stylo-glossus*, *Stylo-hyoideus*, *Stylo-pharyngeus*; and to it the Ligament of the *Os hyoides* is fixed. This Process is often even in Adults not entirely ossified, but is separated at its Root from the *Os temporum*, and sometimes is composed of two or three distinct Pieces. Round the Root of it, especially at the Forepart, there is a remarkable Rising of the *Os petrosum*, which some have esteemed a Process, and from the Appearance it makes with the *Styliform* have named it *Vaginalis*. Others again have, under the Name of *Auditory Process*, reckoned among the external Processes that semicircular Ridge, which running between the Root of the *mastoid* and *zygomatic* Processes, forms the Under-part of the *Meatus auditorius externus*.

The Sinuosities or Depressions on the external Surface of each *Os temporum* are these: A long *Fossa* at the inner and back Part of the Root of the *mammary Process*, where the posterior Head of the *digastric* Muscle has its Origin. Immediately before the Root of the *zygomatic Process* a second considerable Hollow is left, for lodging the *crotaphite* Muscle. Between the *zygomatic*, *auditory* and *vaginal* Processes, a large Cavity is formed; through the Middle of which, from Top to Bottom, a Fissure is observable, into which the Ligament that secures the Articulation of the lower Jaw with this Bone is fixed. The anterior Part of the Cavity being lined with the same Cartilage which covers the Tubercle before it, receives the *Condyle* of the Jaw; and in the posterior Part a small Share of the *parotid Gland* and a
cel-

cellular fatty Substance are lodged. At the interior Side of the Root of the *styloid Apophyse* a remarkable Cavity is found where the Beginning of the internal jugular Vein, or End of the lateral *Sinus* is lodged; and round the *Meatus auditorius externus* several Sinuosities are formed for receiving the Cartilages and Ligaments of the Ear, and for their firmer Adhesion.

The proper *Foramina* or Holes that *Holes.* commonly appear on the Outside of each of these Bones are five. *First*, Between the *zygomatic* and *mastoid* Processes is a large Funnel-like Canal excavated in the Bone, which leads to the Organ of Hearing; therefore is called *Meatus auditorius externus**. The *Second* is the Aqueduct of *Fallopins*, or Passage for the *Portio dura* of the auditory Nerve, to be seen between the *mastoid* and *styloid* Processes. Some way before, and to the Inside of the *Apophysis styloides*, is the *Third Foramen*, which runs first upwards, then forwards, and receives into it the internal *carotid* Artery, and Beginning of the intercostal Nerve; where this Canal is about to make the Turn forwards, one or sometimes two very small Holes go off towards the *Tympanum*, thro' these *Valsalva* (a) affirms the proper Artery or Arteries of the *Tympanum* are sent. On the anterior Edge of this Bone, near the former Hole, a *Fourth* is observable, being the Orifice of a Canal, which in a horizontal Direction runs outwards and backwards,

* Πέγῃ τ' ἀκούς, ὅφη ἤϊ ὠτῶν, Fenestra aurium.

(a) De Aure humana Cap. 2. § 22. & Tab. 7. Fig. 1.

wards, till it terminates in the Cavity of the Ear, called *Tympanum*. This in the recent Subject is continued forward and inward from the Parts which I mentioned just now as its Orifice in the Skeleton to the Side of the Nostriis, being partly cartilaginous and partly ligamentous. The whole Canal is named *Iter à palato ad aurem*, or *Tuba Eustachiana*. On the external Side of the bony Part of this Canal, and atop of the Chink in the Cavity that receives the *Condyle* of the lower Jaw, is the Course of the little Nerve said commonly to be reflected from the lingual Branch of the fifth Pair, till it enters the *Tympanum* to run across this Cavity, and to have the Name of *Chorda Tympani*. The *Fifth* Hole is very uncertain, appearing sometimes behind the *mastoid* Process; otherwhiles it is common to the temporal and occipital Bones; and in several Skulls there is no such Hole. The Use of it, when found, is for the Transmission of a Vein from the external Teguments to the lateral *Sinus*: But in some Subjects I have seen a Branch of the occipital Artery pass through this Hole, to serve the posterior Part of the *dura Mater*; in others I have seen two or three such Holes: But they are oftner wanting than found. And now once for all we may in general remark, That the Magnitude, Number, Situation or Existence of all such Holes, that for the most part allow only a Passage for external Veins to the internal Receptacles, are very uncertain.

The internal Surface of the *Ossa* Internal
temporum is unequal, the superior cir- Surface.
 cular Edge of the squamous Part hav-

ing numerous small Ridges and Furrows for its Conjunction with the parietal Bones; and the rest of this Surface of the temporal Bones being imprinted with undulating Depressions and Risings, answering to the Convolutions of the middle Part of the Brain, and with Furrows made by the Branches of the Arteries of the *dura Mater*.

From the under Part of this internal *Processus*. Surface, a large transverse hard craggy Protuberance of this Bone, runs horizontally inwards and forwards, with a sharp Edge above, and two flat Sides, one facing obliquely forwards and outwards, and the other as much backwards and inwards. To the Ridge between these two Sides, the large lateral Process of the *dura Mater* is fixed. Within this *Os petrosum* the four little Bones and other auditory Parts are contained; the Description of which I shall here designedly omit, as more proper, in my Opinion, to be demonstrated with the other Organs of Hearing.

Sometimes a small Bone of kin to the Sesamoid, is found between the small Extremity of this *petrous* Process and the *sphenoid* Bone, as is remarked by *Winslow* (a) after *Riolan*.

Towards the posterior Part of the *cavities*. *Os temporum*, a large deep *Fossa* is conspicuous where the *Sinus lateralis* lies, and frequently on the Top of the *petrous* Ridge, a Furrow may be observed, where a small Sinus is situated.

The internal proper *Foramina* of each *Holes*. of these Bones are, First, The *Meatus auditivus*.

(a) Exposition Anatomique de corps humain, Traité des Os Secs, § 266.

auditorius internus, in the posterior plain Side of the *Processus petrosus*. This Hole soon divides into two, one of which is the Beginning of the *Aqueduct* of *Fallopins*, the other ends in three or four, *Valsalva* (a) says, six Canals, that allow a Passage to the Branches of the *Portio mollis* of the seventh Pair of Nerves, into the *Vestibulum* and *Cochlea*. Through it also an Artery is sent, to be distributed to the Organ of Hearing. The second Hole which is on the anterior plain Side of the craggy Process gives Passage to a Branch of the lateral Artery of the *Dura Mater*, which joins the *Portio dura* of the auditory Nerve, while it is in the *Aqueduct*; for the Discovery of this we are obliged to *Fallopins* (b). Frequently however a Branch of the *Portio dura*, which I suppose to be the same with what *Valsalva* (c) mentions, accompanied with a Branch of that Artery which went into the *Meatus auditorius* along with the acoustick Nerve enters into the *Cranium*, here to be distributed to the soft Parts at the Side of the *Sella turcica*. Near to this second Hole, several small ones may often be observed, where small Arteries or Twigs of Nerves enter; and on the posterior Surface near the auditory *Foramen*, other small Holes, some pretty remarkable, may be taken notice of: They seem only to convey Vessels to the Substance of the Bone. The Passage of the cutaneous Vein into the lateral *Sinus*, is seen about the middle of the large *Fossa* for that *Sinus*;

1 2

(a) De aure humana, cap. 3. § 11.

(b) Observ. Anatom.

(c) De aure, cap. 3. § 10.

nus; and the Extremity of so much of the Canal of the *carotid* Artery, as is formed in this Bone, is evident at the anterior Under-part of the *petrous* Process. Besides these Holes on the external and internal Surface of each *Os temporum*, which are already described, and are proper to this Bone, there are two other of each Side, which appear both without and within the Skull, and are common to this Bone with the *Os occipitis* and *sphenoides*, and shall afterwards be mentioned in the Description of these two Bones.

The superior round Part of the *Substance*. squamous Bones is thin, but equal; while the inferior petrous Part is thick and strong, but irregular and unequal, having the Distinction of Tables and *Diploe* confounded, with several Cavities within its Substance, which belong to the Organ of Hearing.

The temporal Bones are joined *Conjunction*. above to the parietal Bones by the squamous Sutures, and their posterior *additamenta*: Before, to the *sphenoid* Bone by the Suture of that Name; to the *Ossa malarum* by the *zygomatick* Sutures: Behind, to the *Occipital* Bone by the *Lambdoid* Suture and its *Additamenta*.

The Purposes which these two Bones *Uses*. serve, are easily collected from the general Use of the *Cranium*, and from what has been said in the Description of their several constituent Parts.

In an Infant a small Fissure is to *of Infants*. be observed between the thin superior Part, and the inferior craggy Part

Part of each of these Bones, which points out these Parts being but lately conjoined; neither *Mastoid* nor *Styloid* Processes are yet to be seen; but are afterwards added in the Form of *Epiphyses*: And instead of a bony Funnel-like *meatus auditorius externus*, there is only a smooth bony Ring within which the *Membrana Tympani* is fastened; at the Entry of the *Tuba* of *Eustachius*, the Side of the *Tympanum* is not completed. A little more externally than the internal auditory Canal, there is a deep Pit left, over the superior Part of whose Orifice, the interior semicircular Canal of the Ear is stretched. Some Way below which, the posterior semicircular Canal also appears manifestly.

OS OCCIPITIS *, so called from its Situation, is in the *Os Occipitis*. same Manner as the other Bones of the Scull, convex on the Outside, and concave internally. Its Figure is an irregular Square or rather *Rhomboid*; the superior Angle of which is generally a little rounded: The two lateral Angles are more finished but obtuse; and the inferior Angle is stretched forwards in Form of a Wedge, and thence is by some called the *cuneiform* Process. If one would however be very nice in observing the several Turns which the Edges of the *Os Occipitis* make, five or seven Sides and as many Angles of this Bone might be described.

The external Surface is mostly convex, except at the cuneiform Apophyse, where it is flatned. At the Base

*External
Surface.*

I 3

of

* *Ivoy*, *Basilare*, *Proræ*, *Memoriæ*, *Pixidis*, *Fibrosum*, *Nervosum*, *Lambdæ*.

of this triangular Process, on each Side of the great Hole, but more advanced forwards than the middle of it, the large oblong Protuberances, named the *Condyles Processes*, appear, to serve for the Articulation of this Bone with the first *Vertebra* of the Neck. The smooth Surface of each of these *Condylloid* Processes, is longest from behind forwards, where by their oblique Situation they come much nearer to each other than they are at their posterior Part. Their interior Sides are lower than the external, by which as *Galen* (a) well remarks they are prevented from sliding to either Side out of the Cavities of the first *Vertebra*. In some Subjects each of these plain smooth Surfaces seems to be divided by a small Rising in its Middle; and the inferior Edge of each Condyle next the great *Foramen*, is discontinued about the Middle, by an intervening Notch, which gave *Diemerbroeck* (b) Ground to alledge, that each of these *Apophyses* was made up of two Protuberances. Round their Root a small Depression and spongy Roughness is observable, where the Ligaments for surrounding and securing the Articulations adhere. Concerning these *Condyles* it is to be remarked, that tho' the Motion of the Head is performed on them, yet the Center of Gravity of that Globe does not fall between them; but is a good Way further forward; by which Mechanism it is evident, that the Muscles which pull the Head back, must act with a considerable Disadvantage, in respect of their Anta-

(a) De usu part. lib. 12. cap. 7.

(b) Anat. lib. 9. cap. 6.

Antagonists; and that these Extensors must be in a constant State of Contraction, which is superior to the natural Contraction of the proper Flexors; else the Head would always fall forwards, as it does when a Man is asleep, or labours under a Palsy, as well as in all Infants, where the Weight of the Head far exceeds the proportional Strength of these Muscles. This seeming disadvantageous Situation of these Condyles is however of good Use to us, by allowing sufficient Space for the Cavities of the Mouth and *Fauces*, and for lodging a sufficient Number of Muscles, which properly serve for other Uses, but may at pleasure be directed to act on the Head, and then have as well as the proper Flexors, an advantageous Lever to act with, so as to be able to sustain a considerable Weight appended, or other Force applied, to pull the Head back.

Somewhat more externally than the *Condylloid* Processes, we remark on the occipital Bone a small Rising and semilunated Hollow of each Side, which make up Part of the *Foramina* common to this Bone with the *ossa petrosa*; immediately behind which on each Side, a scabrous bony Ridge is extended from the Middle of the Condyle towards the Roots of the *Mastoid* Process: Into this Ridge the *Musculus lateralis* commonly ascribed to *Fallopianus* is inserted. About the Middle of the external convex Surface, a large Arch runs cross the Bone, from the superior lateral Parts of which, the *Musculi occipitales* have their Rise; to the Middle of it the *Trapezii* are attached; and into the inferior Part of it, some tendinous Fibres of the *Complexi* and *Splenii* are fixed. In the
Hollow

Hollow immediately below the Middle of this Arch, the *Complexi* are inserted, and in the Depressions more external than this, the *Splenii* are inserted. Below these, an oblique Ridge is extended, to which the exterior Fibres of the *recti majores* and of the superior oblique Muscles are fixed, and the fleshy Insertions of these Muscles make Depressions below this. Lower still, and nearer the Middle of the Bone, the little hollow Marks of the *recti minores* appear. Through the Middle of the two Arches a small sharp Ridge runs, which has the Name of *Spine* bestowed on it by some, as indeed Anatomists commonly do apply this Name to all the long narrow-edged Protuberances of Bones. This Spine serves as some Sort of Partition between the Muscles of different Sides, or rather is owing to the Action of the Muscles depressing the Bone on each Side of it, while this Part is free from their Compression. These Prints of the Muscles on this Bone are very strong and plain in some Subjects, but are not so distinct in others. All round the great *Foramen* the Edges are unequal, for the firmer Adhesion of the strong circular Ligament, which goes thence to the first *Vertebra*. Between the two *Condyles*, are two small Risings and Depressions, where the Ligaments from the Tooth-like Process of the second *Vertebra* of the Neck are fixed: And immediately before these, two little Depressions are made in the external Surface of the cuneiform Process, for the Insertion of the *Musculi recti anteriores minores*, generally, tho' unjustly alledged to be first discovered by *Cowper*. And still further forward, nearer the cuneiform

cuneiform Bone, are two other such Depressions, for the Reception of the *Recti anteriores majores*.

On the internal Surface of the *Oss occipitis*, we see two bony Ridges, one standing perpendicular, the other running horizontally across the first. Internal Surface.

The superior perpendicular Leg of this Cross to which the *Falx* is fixed, is hollowed in the Middle, or often of one Side, for the Reception of the *Sinus longitudinalis superior*; and the inferior Leg has the small or third Process of the *dura Mater* fastned to it, and is sometimes hollowed by the occipital Sinus. The cross horizontal Legs have each a Canal formed in them, that of the Right Side being generally a Continuation of the *Fossa* in the superior perpendicular Leg of this Cross: These horizontal Canals serve to lodge the lateral Sinuses inclosed in the second or transverse Process of the *dura Mater*. Round this Cross are four large Depressions; the two superior are formed by the posterior Lobes of the Brain, and the two inferior by the *Cerebellum*. Before these last Cavities, are the Extremities of the *Fossæ* of the lateral Sinuses. The cuneiform Apophyse is internally made hollow for the Reception of the *Medulla oblongata*, and a Furrow remarked by *Albinus* (a), is made on each Side, near the Edges of this Process, by a *Sinus* of the *dura Mater*, which empties itself into the lateral Sinus.

The *Foramina* of this Bone are commonly five proper, and two common to it, and the *Ossa temporum*. Holes. The first of the

(a) De ossib. § 65,

the proper is the large round one immediately behind the Wedge-like Process. This Hole allows a Passage to the *Medulla oblongata*, *Nervi accessorii Willisii*, the vertebral Arteries, and sometimes to the vertebral Veins; *Foramen magnum occipitis* * is the Name this generally obtains. At each Side of this big Hole, near its anterior Part, we always find a Hole, sometimes two, which soon unite again into one that opens externally, immediately above the *Condylaid* Processes; thro these the Ninth Pair of Nerves go out of the Scull. The fourth and fifth Holes are these, that on each Side pierce from behind the *Condyles* into the *Fossæ* of the lateral *Sinuses*; they serve for the Passage of the cervical Veins to these *Sinuses*. Often one of these Holes is wanting, sometimes both, when the Veins pass through the great *Foramen*. Besides these five, we frequently meet with other Holes near the Edges of this Bone, for the Transmission of Veins; their Number and Diameter is very uncertain, tho' they are sometimes very large. The two common *Foramina* are these large irregular Holes, one on each Side, between the Sides of the *Processus cuneiformis*, and the Edges of the *Ossa petrosa*. In a recent Subject, a strong Membrane runs cross from one Side to the other of each of these Holes; and in some Heads I have seen this Membrane ossified, or a bony Partition dividing each Hole; and in the greater Number of adult Sculls there is a small sharp-pointed Process stands out from the *Os petrosum*, and a more obtuse Rising in the occipital Bone between

* Rachitidis, Medullæ spinalis.

tween which the Partition is stretched. Behind this *Septum*, where the largest Space is left, the *Sinus lateralis* has its Passage; and before it the eight Pair of Nerves and *Accessorius Willisii* make their Exit out of the Skull; and some Authors say, an Artery passes through this Hole to be bestowed on the *dura Mater*.

The *Os Occipitis* is among the thickest Bones of the *Cranium*, tho' *Substance* unequally so; for it is stronger above, where it has no other Defence than the common Teguments; but below being pressed by the Lobes of the Brain and *Cerebellum* on one Side, and Action of the Muscles on the other, it is so very thin, as to be in many Skulls diaphanous: But then these Muscles ward off any Injury, and the Ridges and Spines which are frequent here, make it sufficiently strong to resist the ordinary Force of Weapons. All through this Bone, the Tables and *Diploe* are tolerably distinct, except where it is so thin as to become diaphanous.

The occipital Bone is joined above to the *Ossa parietalia* and *Tri-Connexion* *quetra*, by the *Lambdoid Suture*; laterally to the *ossa temporum*, by the *Additamenta* of the *Lambdoid Suture*; below to the *sphenoid Bone* by the Extremity of its own cuneiform Process, in the same Way that Epiphyses and their Bones are joined: For in Children a ligamentous Cartilage is interposed between the occipital and sphenoid Bones, which gradually turns thinner by each of the Bones advancing till their Fibres at last run into each other; and about sixteen or eighteen Years of Age the Union of these two Bones becomes so inti-

intimate, that a Separation cannot be made without Violence. The *Os occipitis* is articulated below with the first *Vertebra* of the Neck, by what I have described as the third or long *Species* of *Ginglimus*; for each Condyle is received into a superior oblique Process of that *Vertebra*. What Motion is allowed here, we shall consider afterwards, where the *Vertebrae* are described.

The Uses of this Bone are all included in the Description, therefore need less to be repeated.

An Infant born to the full Time, *In Children.* has this Bone divided by unossified Cartilages, into four Parts; the first of these is larger than the other three, is of a triangular Shape, and constitutes all the posterior Part of the Bone above the great *Foramen*; generally Fissures appear in the upper Part and Sides of this triangular Bone, when all the Cartilage is separated by Maceration; and sometimes little distinct Bones are seen towards the Edges of it. The second and third Pieces of this Bone are exactly alike, and situated on each Side of the great *Foramen*, from which, very near the whole Condyles are produced, and they are extended forwards almost to the anterior Side of the Hole for the ninth Pair of Nerves. The fourth Piece is the cuneiform Process, which forms a small Share of the great *Foramen*, and of the Condyles; and betwixt it and the *sphenoid* Bone a Cartilage is interposed.

There are only two Bones of the eight which belong to the *Cranium*, now left undescribed, *viz.* the *Ethmoid* and *Sphenoid*. These we already

already mentioned, as by most Authors reckoned common to the *Cranium* and Face, because they enter into the Composition of both, as we shall see they indeed do; but then it is a Question, whether by the same Parity of Reason the *frontal Bone* ought not also to be esteemed common: But to pass any idle Dispute about the Propriety of ranging them, let us proceed to examine the Structure of the Bones themselves.

*OS ETHMOIDES**, or Sieve-like Bone, has got its *Os Ethmoides*. Name from the great Number of small Holes with which that Part of it first taken Notice of and described, is pierced. When this Bone is entire, the Figure of it is not easily described, but by a Detail of its several Parts, some Idea may be afforded of the whole; and therefore I shall distinguish it into the *Cribriform lamella* with its Process, the *Nasal lamella*, *Cellulae*, and *Ossa spongiosa*.

The internal, plain, thin, horizontal *Lamella*, with a middle perpendicular Protuberance called *cri-* *Cribriform
Lamella.*
sta galli †, from its Resemblance to a Cock's Comb, is universally known. Round this Process, except at the posterior Part, the *Lamella* is perforated obliquely by a great Number of small Holes, through which the Filaments of the olfactory Nerves pass. In a recent Subject, these *Foramina* are so closely lined by the *dura Mater* that they are much less

K conspi-

* Cribriforme, σπογγώδες, Spongiforme.

† Verruca pradura, septum ossis spongiosi.

conspicuous than in the *Skeleton*. The *Crista galli* is much thicker and stronger than the Base it is supported by, and ends in a Ridge sloping backwards and downwards, to which, and the posterior unperforated Part of the *Lamella*, the Beginning of the *Falx* is connected. Immediately before the highest Part of this Process, is the blind Hole of the *Os frontis*, which as we remarked before, is often in a good Measure formed by a Notch in the anterior Edge of the *Crista*.

From the middle of this *Cri-Nasal Lamella*. *cribriform Lamella*, a thin solid perpendicular Process stands out externally, resting on the same common Base with the *Crista galli*; tho' for the most Part, this external Plate is not entirely perpendicular, but inclined to one Side or other, and therefore divides the Cavity of the Nose unequally: This *nasal Lamella* is thin at its Rise, and rather still thinner in its Middle, yet afterwards, at its anterior Extremity, it becomes thicker, that its Conjunction with the Bones and middle Cartilage of the Nose might be firmer. Hence we may see, that if the Bones of the Nose are broke by a Force applied in a perpendicular Direction to this Plate, the *cribriform Lamella* may be in great Danger, and consequently the Effects of such a Fracture may prove fatal.

At a little Distance from each Side *Cellula*. - of this external Process, a cellular and spongy bony Substance is conspicuous. The Number and Figure of the Cells, which are on the superior, posterior and lateral Part of this irregular Process of each Side, are very

ry uncertain, and not to be represented in Words; only all the Cells communicate with each other, and with the Cavity of the Nose; the superior into which the frontal *Sinuses* open, are formed like a Funnel. The external posterior Surface of these Cells is smooth and plain, where this Bone assists in composing the Orbit, at which Place on each Side it has got the Name of *Os planum*, on the superior Edge of which, a small Notch or two are sometimes observed, which go to the Formation of the *Foramina orbitaria interna*, as was remarked in the Description of the *Os frontis*.

The spongy Bones are on the inferior internal Part of these *Cellulae*; *Ossa spon-*
their Figure is somewhat elliptical, *giosa.*
only each terminates in two sharp
Extremities, one of which points obliquely
backwards, and the other forwards. The Ex-
tent of these Bones is marked on their outside,
where they are concave, by a deep Furrow
surrounding their Base. Their internal Sur-
face next the *Septum nasi* is convex. These
two Processes of the *Ethmoid* Bone, have
from their Substance, Figure and Situation
got the Name of *Ossa spongiosa*, or *turbinata*
superiora.

All the Prominencies, Cavities
and *Meanders* of this *ethmoid* Bone, *Connexion.*
are covered with the Membrane of
the Nostrils, in a recent Subject. The hori-
zontal cribriform *Lamella* of this Bone is lodg-
ed in the Discontinuation of the *Os frontis*, be-
tween its orbital Processes, to which it is join-
ed by the *ethmoid* Suture, except at the po-
sterior Part, where it is articulated with the

Cuneiform, by a Suture common to both the Bones, tho' it is generally esteemed Part of the *Sphenoidal*. Where the *Ossa plana* are contiguous to the frontal Bone within the Orbit, their Conjunction is reckoned Part of the Transverse Suture. Farther forward than the *Ossa plana*, the Cells are covered by the *Ossa unguis*, which are not only contiguous to these Cells, but cannot be separated from them, without breaking the bony Substance; and therefore in Justice, those Bones ought to be demonstrated as Part of the *Ethmoid* Bone. Below the *Ossa unguis* and *Plana* these Cells and *Ossa spongiosa* are overlop'd by the *Ossa maxillaria*: And the cellular Part of the *Ossa palati*, is contiguous to the *Ossa plana* and Cells backwards. The lower Edge of the Nasal perpendicular *Lamella* is received into a Furrow of the *Vomer* by *Schindylesis*: Its posterior Edge is joined to the anterior Part of the *Processus azygos* of the *sphenoid* Bone. Its superior Extremity joins the Nasal Process of the *Os frontis* and *Ossa nasi*, and its anterior Edges are conjoined to the middle Cartilage of the Nose.

From all which, the Uses of this *use*. Bone are evident, *viz.* to sustain the anterior Lobes of the Brain; to allow the olfactory Nerves a safe Passage, and the *Falx* a sure Attachment; to enlarge the Organ of Smelling, or Membrane of the Nose stretched on the Contortions of this Bone; to straiten the Passage of the Air through the Nose, by leaving only a narrow winding Canal, on the sensible membranous Sides of which, all the Substances conveyed along with the Air must strike;

strike ; to form Part of the Orbit of the Eyes and *Septum narium*, while all its Parts are so light as not to be uneasy, or in hazard of separating by their Weight, and so thin as to form a large Surface, without occupying much Space ; and at the same time this brittle Substance is sufficiently protected from external Injuries, by the firm Bones which cover it. But if once this Bone is seized on by any corroding Matter, we may easily conceive what Destruction may be made : And hence it is, that an *Ozæna* is so ill to cure, or that in violent *Scurvies*, or in the *Lues Venerea*, the Fabrick of the Nose, the Eyes and Life itself are in so much Danger.

The *Ethmoid* Bone is pretty complete in ripe Children, only the *Cri-* *of Infants.*
sta galli and nasal *Lamella* are still cartilaginous, by which this Bone is in such Subjects divided into two.

*OS SPHENOIDES**, or Wedge-like Bone, so called because by its *Os sphenoides.*
Position in the Middle of the Bones of the *Cranium* and Face, it bears, say Authors, some Analogy to that Instrument. It is of a very irregular Figure, nor do I know any Thing to which it may be likened, unless perhaps it bear some faint Resemblance to a Bat with its Wings extended.

When we view the *Os sphenoides* externally, five remarkable Processes *External Surface.*
may be observed, which are all of them again subdivided. The first and *Processes.*
second are the two large lateral *Apo-*

K 3

physes

* Cuneiforme, *πολύμορφον*, multiforme, paxillum, cribratum, palati, colatorii, cavilla, basilare,

phyfes or Wings; the superior Part of each of which is called the *Temporal Process*, because they join with the temporal Bones in forming the Temples, and Seat for some Share of the *crotaphite* Muscles. That Part of the lateral Processes which jets out towards the Inside, somewhat lower than the temporal *Apophyses*, and is smooth and hollowed, where it makes up Part of the Orbit, is thence named *Orbital Processes*. Behind the Edge separating these two Processes there is often a small Groove, made by a Branch of the superior maxillary Nerve in its Passage to the temporal Muscle. The lowest and back Part of the Wings, which runs out pretty sharp to meet the *Ossa petrosa*, has been stiled *Apophyses spinosæ*: From near the Point of which a sharp-pointed Process is frequently produced downwards, which some call *Styliform*, that affords Origin to the *Ptery-staphylinus externus* Muscle. From this styloid Process a very small Groove is extended along the Edge of the Bone to the Hollow at the Root of the more internal Plate of the following Processes, which *Winslow* (a) rightly describes as Part of the *Eustachian Tube*. The third and fourth external Processes of the *cuneiform* Bone are the two which stand out almost perpendicular to the Base of the Skull, with two Sides and a middle *Fossa* behind to each of them, and should, to carry on our first Comparifon, be likened to the Bat's Legs, but are commonly said to resemble the Wings of that Creature, and therefore are well known by the Name of *Pterygoid*

(a) Exposition Anatomique du corps humain traité des Os secs, § 233.

goid or *Aliform* * Processes. The two Sides of each are called *Alæ* or Wings: The external are broadest, and the internal longest. From each Side of the external *Alæ* the *pterygoid* Muscles take their Rise. At the Root of each internal Wing a small Hollow may be remarked, where the *Musculus ptery-staphylinus internus* rises, and some Share of the cartilaginous Extremity of the *Tuba Eustachiana* rests; and at the lower Extremity of the same Wing is a Hook-like Rising or Process of the Bone, round which the Tendon of the last named Muscle plays, as on a Pulley: From the Edge of the external Wings some small sharp Spikes stand out; but their Number and Bulk are uncertain. The fifth external Process of the *sphenoid* Bone is that sharp middle Ridge which stands out from the Base of this Bone: Because it wants a Fellow, it may be called *Processus azygos*. The inferior Part of this Process, where it is received into the *Vomer*, is pretty thick, and often not quite perpendicular, but inclining more to one Side than the other. The anterior Part of this Process, where it joins the nasal *Lamella* of the *Os Ethmoides*, is thinner and straighter. These two Parts have been reckoned two distinct Processes by some.

The Depressions, Sinuosities and *Fossæ* on the external Surface of this *sphenoid* Bone, may be reckoned up to a great Number; as, two on the temporal *Apophyses*, where the *crotaphite* Muscles lodge; two on the *orbital* Processes, to make way for the

* Naviculares,

the Globes of the Eyes; two between the *temporal* and *spinous Apophyses*, for receiving the temporal Bones; two between the Wings of the *pterygoid* Processes, where the *Musculi pterygoidei interni* and *Ptery-staphylini interni* are placed; two between the *pterygoid* and *orbital* Processes, for forming the Holes common to this Bone, and to the *Ossa malarum* and *maxillaria*; two on the inferior Extremities of the *aliform* Processes, which the *Ossa palati* enter into; two at the Roots of the *temporal* and *pterygoid* Processes, where the largest Share of the external *pterygoid* Muscles have their Rise; two at the Sides of the *Processus azygos*, for forming Part of the Nose, &c.

On the internal Surface of this Bone three *Apophyses*, besides the *temporal* and *spinous* Processes, which are seen here too, are commonly described, *viz.* two at the anterior, and a broad one at the posterior Part of the Body of this Bone, which are called *Clinoid*, from their Resemblance to the Supporters of a Bed. The two first frequently are joined with the Sides of the last, or with the Body of the Bone itself, by a bony Cross-bridge, under which the *carotid* Arteries pass. Then the anterior *clinoid* Processes are stretched out a good Way forward and outwards on each Side, to terminate in a very sharp Point, which have been esteemed distinct Processes by the Name of *Transversi Spinosi*; and the posterior *clinoid* Process has a small Protuberance on each Side, which hath been reckoned a Process also. Between, but a little farther back than the

the two anterior *clinoid* Processes, a small Protuberance rises from the Bone somewhat in Figure resembling the posterior *clinoid* Process, but not near so large. And often from the Body of the Bone, between the transverse Processes, another Protuberance forces itself forwards into the *Os Ethmoides*.

Within the Scull there are two Sinuities in the internal Part of each *Cavities*. Wing of the *sphenoid* Bone, for receiving the middle Part of the Brain; one between the transverse spinous Processes, for lodging the *Crura medullæ oblongatæ*; and immediately before the third or middle *clinoid* Rising, a single Pit generally may be remarked, from which a *Fossa* goes out on each Side to the *Foramina optica* of this Bone. The Pit is formed for the conjoined optick Nerves; and in the *Fossæ* these Nerves are lodged, as they run divided within the Scull. Between that third Protuberance and the posterior *clinoid* Process, the large Pit for the *Glandula pituitaria* may be remarked. This Cavity, because of its Resemblance to a *Turkish* Saddle, is always described under the Name of *Sella Turcica* or *Ephippium*. On the Sides of the posterior *clinoid* Process a *Fossa* may be remarked, that stretches upwards, then is continued forwards along the Sides of the *Sella Turcica* near to the anterior *clinoid* Processes, where a Pit on each Side is made. These *Fossæ* point out the Course of the two *carotid* Arteries after they have entred the Scull. Besides all these, several other *Fossæ* may be observed, leading to the several *Foramina*, and imprinted by the Nerves and Blood-vessels.

The

The *Foramina* of the *Os sphenoides* are
Holes. on each Side, six proper, and three
 common. *First* is the round Hole immediately below the anterior *clinoid* Processes, for the Passage of the optic Nerve, and of the Branch of the internal *carotid* Artery that is sent to the Eye. *Second* is the *Foramen lacerum* or large Slit between the transverse spinous and orbitar Processes: The interior Extremity of which Slit is large; and as it is extended outwards, it becomes narrower, and at last the external Extremity of it is formed out of the *Os frontis*: Therefore this might be reckoned among the common *Foramina*. Through it the *Motores oculi*, *Pathetici*, and first Branch of the fifth, the whole sixth Pair of Nerves, except one reflected Branch, according to the most common Descriptions of the Nerves, and an Artery from the internal Carotid, go into the Orbit. Sometimes a small Branch of the external Carotid, described by *Winslow* (a), enters near its Extremity, to be distributed to the *dura Mater*; and a Vein, some call it *Ductus venosus*, or *Nuck's Aqueduct*, returns to the superior petrosal *Sinus*. *Third* is a round Hole behind the former, allowing a Passage to the second Branch of the fifth Pair of Nerves, or superior maxillary Nerves, into the Bottom of the Orbit. To distinguish this Hole, Authors have, from its Figure, given it the Name of *Foramen rotundum*. *Fourth* is the *Foramen ovale*, about half an Inch behind the round Hole. Through it

(a) Exposition Anatomique de corps humain, traité des Arteres, § 60. & Dela Tete § 26.

at the third Branch of the fifth Pair of Nerves, or *maxillaris inferior*, goes out; and sometimes I have seen a Vein from the *dura Mater* passing out here, as observed by *Ingrassias* (a). Very near the Point of the spinous Process, the *Fifth* Hole of this Bone appears: It is small and round, for a Passage to the Artery of the *dura Mater*, which often is accompanied with a Vein. The *Sixth* proper Hole seems to be mentioned by *Vesalius* (b), is obscurely painted by *Eustachius* (c); but is, in my Judgment: first fully described and delineated by *Vidius* (d), and has been neglected by Anatomists till of late. It is not well to be seen, till the cuneiform Bone is separated from all the other Bones of the *Cranium*; for the Beginning of it is hid by a small Protuberance of the internal *Ala pterygoidea*, and by the Extremity of the *Processus petrosus* of the *Ostemporum*. It runs above the inner Wing of the *pterygoid* Process, and where it opens into the Cavity of the Nose, is concealed by the thin laminous Part of the *Os palati*. Through it an Artery from the external *Carotid* runs, to be distributed to the Nostrils: So that as this Hole does not pierce within the *Cranium*, it differs from all the other *Foramina* of this Bone already described. In several Subjects, soon after the Entry of this Artery, a small Branch goes backwards from it to the *Fossa pterygoidea*,
and

(a) Commentar. in Galen. de Ossib. lib. 1. comment. 8.

(b) Anat. lib. 1. cap. 12.

(c) Tab. 46. fig. 13 & 16.

(d) De Anat. lib. 2. cap. 2. Explic. tab. 5. & tab. 5. fig. 2, 9, 10. lit. O.

and a second pierces the Scull to serve the *dura Mater*. Often in the Middle of the *Sella Turcica* a small Hole or two appear, piercing as far as the cellular Substance of the Bone; and sometimes at the Sides of this *Sella* one or more small Holes penetrate into the *Sinus sphenoidales*. These Observations afforded *Sylvius* (a) and *Laurent* (b) an Argument of some Weight in those Days in defence of *Galen* (c), to prove the Descent of the *Pituita* that Way into the *Sinuses* below.

The *First* of the common Holes is that unequal Fissure at the Side of the *Sella Turcica*, between the extreme Point of the *Os petrosum* and the *Processus spinosus* of the cuneiform Bone. This Hole only appears after the Bones are boiled; for in a recent Subject a considerable Part of it is covered by a thin bony Plate that lyes over the internal carotid Artery, and the anterior Part is filled with a cartilaginous Ligament, under which the cartilaginous Part of the *Tuba Eustachiana* is placed: Sometimes however a Branch of that Artery which enters the sixth *Foramen pterygoideum* is sent through this Substance to the *dura Mater*. Here it was the Ancients believed that the *Pituita* drivelled down from the Emunctory of the Brain, the *Glandula pituitaria*, to the *Fauces*. The *Second* common Hole is that large Discontinuation of the external Side of the Orbit, left between the orbitar Processes of the cuneiform Bone, the

(a) *Calumniæ secundæ amolitiō.*

(b) *Hist. Anat. lib. 2. quæst. 11.*

(c) *De usu Part, lib 9.*

the *Os maxillare, male* and *Palati*. In this large Hole the Fat for lubricating the Globe of the Eye and temporal Muscle is lodged, and Branches of the Superior maxillary Nerve, with small Arteries from the Carotid and their Veins pass. The *Third* Hole is formed between the Base of this Bone and the Root of the orbitar Process of the Palate-bone of each Side. Through this a Branch of the external carotid Artery, and of the second Branch of the fifth Pair of Nerves, are allowed a Passage to the Nostrils, and a returning Vein accompanies them. Sometimes however this Hole is proper to the Palate-bone, being entirely formed out of its Substance.

Under the *Sella Turcica*, and some Way farther forward, but within the *Sinus*. Substance of the *sphenoid* Bone, are two *Sinuses*, separated by a bony Plate, much of kin to those of the *Os frontis*. They open into the superior and posterior Part of each Nostril by a round Hole, which is at their upper anterior Part. This Passage is not framed by the *Os sphenoides*, which has an Aperture near as large as any transverse Section of the *Sinus*, but by the *Ossa palati*, which are applied to the anterior Part of these *Sinuses*, and close them up, that Hole only excepted, which was already mentioned. Frequently the two *Sinuses* are of unequal Dimensions, and sometimes there is only one large Cavity, with an Opening into one Nostril. — *Albinus* (a) has described these Cavities, extended sometimes as far back as the great *Foramen* of the occipi-

L

tal

(a) De Orib. § 39.

tal Bone. In other Subjects they are not to be found, when, as *Vesalius* (a) observes, the Bone is composed of large Cells. The same Author also describes a Cavity within the Partition of the *Sinuses*; but this seldom is any thing remarkable. These *Sinuses* are lined with the same sort of Membrane, and serve the same Uses as the frontal.

As this Bone is extremely ragged
Substance. and unequal, so its Substance is very different, being in some Places diaphanous, in others of a middle Thickness, and its middle posterior Part surpassing the greatest Share of the *Cranium* in Thickness.

The *Os sphenoides* is joined, by its
Connexion. Wings, to the *Ossa parietalia* above, to the *Os frontis* and *Ossa malarum* before, to the *Ossa temporum* behind; by the anterior Part of its Body and spinous Processes, to the *Os frontis* and *Ethmoides*; by the posterior Side of the posterior *clinoid* Processes, to the *Os occipitis*, where it looks like a Bone with the *Epiphyses* taken off, and, as was formerly observed in the Description of the occipital Bone, it is not to be separated without Violence in Adults; to the *Ossa palati*, by the Extremities of the *pterygoid* Processes, and still more by the anterior Part of the internal *Alæ*, as also by the anterior Part of the *Sinuses*; to the *Ossa maxillaria*, by the anterior Part of the external *Alæ*; to the *Vomer* and nasal *Lamella* of the *Os ethmoides*, by the *Processus azygos*. All these Conjunctions, except the last, which is a *Schindylesis*, are said to be by means

(b) Lib. I. cap. 6.

means of the Suture proper to this Bone; tho' it is at first Sight evident, that several other Sutures, as the *transverse*, *ethmoidal*, &c. are confounded with it.

We see now how this Bone is conjoined to all the Bones of the *Cranium*, and most of the upper Jaw; and therefore obtained the Name of the *Wedge-like Bone*.

The Uses and Description are so blended, as to leave nothing new to add *uses* to those which may be collected easily from the foregoing Account.

The *sphenoid* Bone is near complete in a *Fœtus* of nine Months, *In Children*, only the great *Alæ* do after Maceration separate from the Body of the Bone; the *Processus azygos* is very large and hollow; the internal Surface of the Body is unequal and porous, and the *Sinuses* do not appear.

Having thus finished the Description of the *Cranium*, we now proceed to that of the Face.

The *FACE* is the irregular Pile of Bones at the anterior and inferior *The* Part of the Head, divided by *FACE*. *Ant-* thors into two *Maxillæ* or Jaws, *Divided*, Upper and Lower.

The *Superior Maxilla* * is the common Designation given to the *SUPERIOR* upper immoveable Share of the *MAXILLA*, Face; tho', if we would follow *Celsus* (a), we should apply the Word *Maxilla* to the lower Jaw only; and use the Name *Mala* for this upper Jaw. However, in Compliance

* Στράων, γένϑ, Mandibula,

(a) Lib. 8. cap. 1.

plaisance to prevailing Custom, I shall follow the common Terms now employed. The Shape of the superior *Maxilla* cannot easily be expressed; nor is it necessary, provided the Shape and Situation of all the Bones which compose it are described. It is bounded above by the transverse Suture, behind by the anterior Edges of the *sphenoid* Bone, and below by the Mouth.

It consists of six Bones on each Side, and a thirteenth *impar* middle Bone, besides the Teeth. The Names of them are, *Ossa nasi*, - *ossa unguis*, *ossa malarum*, *ossa maxillaria*, *ossa palati*, *ossa spongiosa inferiora*, and *Vomer*.

The *Ossa nasi* are placed at the superior Part of the Nose; the *Ossa unguis* at the internal *Canthi* of the Orbits: *Ossa malarum* form the Prominence of the Cheeks; *Ossa maxillaria*, the Side of the Nose, with the whole inferior anterior Part of the upper Jaw, and the greatest Share of the Roof of the Mouth: *Ossa palati* are situated at the posterior Part of the Palate, *Nares* and Orbit: *Ossa spongiosa* are seen in the lower Part of the *Nares*: And the *Vomer* helps to separate these two Cavities.

These Bones of the upper Jaw are all, except the *Vomer*, and perhaps the *Ossa spongiosa*, joined to the Bones of the *Cranium*, and to each other by Sutures; the Indentations of which are not very conspicuous externally, but plainly appear when the Bones are taken asunder, tho' not near so large as those of the Skull, where there is much more Necessity for Security against both external Injuries and an extruding Force from
with-

within. Often in aged Skulls the Sutures of the upper Jaw are destroyed, for the Bones grow together; which can be of little prejudice, since the greatest Use of any Separation here seems to be no more, than to allow the Bones to be duly extended. Authors have generally distinguished these Sutures by Numbers; but I would rather chuse, with *Vander Linden*, (a), and some few other Writers, to assign particular Names to them; which might, if it was necessary, be easily contrived from their Situation, or the Bones they connect. One must at first View see, from the Manner of the Conjunction of these Bones, that they can have no Motion, except in common with the *Cranium*.

The Purposes which this Pile of Bones serves, will sufficiently appear in the particular Descriptions which shall be given of each, in the same Order in which they were already ranged.

OSSA NASI, so named from their Situation at the Root of the *Nose*, are each of an irregular oblong square Figure, being broadest at their lowest Extremity, narrowest a little higher than their Middle, and becoming somewhat larger at the Top, where they are ragged and thickest, and have a Curvature forwards, that their Connexion with the *Os frontis* might be stronger.

The inferior Edge is unequal, and towards the posterior Part is stretched out, where the Cartilages of the No-

L 3

Sides.

strils

(a) Medicin. physiolog. cap. 13. art. 2. § 10.

strils are connected, that they might be united more firmly. At the interior Part of the anterior Side, they are pretty thick, especially above, and unequal, that their Conjunction to each other might be stronger; and a small Rising may be there remarked, where they are sustained by the *Septum narium*. Their posterior Side, at its superior half, has externally a Depression, where it is overlapped some way by the *Ossa maxillaria*; and the lower half covers these same Bones: By which Contrivance they neither will easily yield to a Pressure applied to their Fore-part or Sides. The Bodies of the *Ossa nasi* are a little convex externally, and concave internally, that they might more strongly resist any Violence offered and might enlarge the Cavities of the Nose. A small Hole is frequently to be observed on their external Surface, into which, two, three or four Holes, which appear internally, terminate, for the Transmission of small Veins.

The *nasal Bones* are firm and solid, with very few *Cellulae* or *Cancelli* to be observed in them, the thin Substance of which they consist, not requiring any great Quantity of Marrow.

They are joined above to the *Ossa frontis*, by the Middle of the transverse suture; behind, to the *Ossa maxillaria*, by a small *Harmonia* or Suture of each Side, which might be called *Nasalis lateralis**; below, to the Cartilages of the Nose; before, to one another by a Suture, which may be

* *Nasalis obliqua*.

be named *Nasalis anterior* †; internally, to the *Septum narium*.

These Bones serve to cover and defend the Root of the Nose. *Uses.*

The *nasal Bones* are in an Infant proportionally shorter and less thick at their upper Part, than in an Adult, but are otherwise complete. *Of Infants.*

OSSA UNGUIS or *LACRYMALIA*: These Names have been given these two Bones, because their Figure and Magnitude is something near that of a Nail of one's Finger, and because the Tears pass upon them into the Nose. *Ossa Unguis.*

Their external Part is composed of two hollow smooth Surfaces and a middle Ridge. The posterior Cavity forms a small Share of the Orbit for the Eye-ball to move on, and the anterior is a deep perpendicular Canal or *fossa* larger above than below, containing the lacrymal *Sac* and *Duct*. This *Fossa* of the Bone appears somewhat cribriform, or has a great Number of small Holes through it, that the Filaments from the Membrane which lines it, insinuating themselves into these Holes, might prevent a Separation of the Membrane, and secure the Bone in its natural Situation: The Ridge between these two Cavities of the *Ossa unguis* is the proper Boundary at this Place of the Orbit. The internal or posterior Surface of this Bone consists of a Furrow in the middle of two Convexities. *External Surface.* *Ductus lacrymalis.*

The

† *Nasalis*, *nasalis recta*,

The Substance of the *Os unguis* is
Substance. as thin as Paper, and very brittle,
 which is the Reason that those Bones
 are so often wanting in Skeletons.

Each of these Bones is joined,
Connexion. above, to the *Os frontis*; behind, to
 the *Os planum* of the *Ethmoid* Bone,
 by Part of the transverse Suture; before, and
 below, to the *Os maxillare*, by a small semi-
 circular Suture, which the Name of *lacryma-*
lis would not be improper to: And internally,
 the *Ossa unguis* cover some of the *Sinus eth-*
moidales; nay, are really continuous with the
 bony *Lamelle*, which make up the Sides of
 these Cells; so that they are as much Part of
 the *Ethmoid* Bone as the *Ossa plana*.

These unguiform Bones compose the
uses. anterior internal Parts of the Orbits,
 lodge the lacrymal Sac and Duct, and
 cover the *Cellula ethmoideæ*. From which
 Situation and tender Substance of these Bones,
 we see how easily a rash Operator may destroy
 a considerable Share of the Organ of Smelling,
 in performing the Operation of the *Fistula la-*
crymalis; but that those Bones, when hurt, will
 with no great Difficulty cast off, and conse-
 quently the Wound be soon cured, unless the
 Patient labours under a general *Cacoethes*, or
 there is a Predisposition in the Bones to a
Caries; in which Case, a large Train of bad
 Symptoms follows, or at best, the Cure proves
 tedious.

These Bones are fully formed in
In a Child. a Child.

OSSA MALARUM * was the Name given by *Celsus*, as was already remarked, to all the upper

Ossa malarum.

Jaw, but is now appropriated to the irregular square prominent Bones, which on each Side form the Cheeks. Their anterior Surface is convex and smooth, the posterior is unequal and concave, for lodging Part of the *Crotaphyte* Muscles.

The four Angles of each of these Bones have been by some reckoned *Processes*, *Proceses*. The posterior superior one, which is the longest and thickest, is called the *superior orbital* Process. The second, or anterior superior, which terminates very sharp, with the two Sides near equally combining to form the Angle, is named the *inferior orbital* Process. The shortest and nearest to a right Angle, which is the anterior inferior, is called *Maxillary*. The fourth or posterior inferior Extremity, is pointed with one Side straight, the other sloping, and is termed *Zygomatic*. Between the two orbital Angles, the concave Arch of a Circle, which makes about a Third of the external Circumference of the Orbit, may be observed, from which a fifth Process is extended backwards within the Orbit, to form near one Third of that Cavity; hence may be called the internal *orbital* Process: About the middle of this, we may remark a considerable Notch, which forms Part of the great Slit at the Outside of the Orbit. From the lower Edge of the *Ossa malarum*, between the maxillary and zygomatick

* Jugalia vel Zygomatica, hypopia, subocularia,

matick Processes, the *Masseter* Muscle takes its Origin; and from the exterior Surface of the *Zygomatic* Process the *Musculus distortor oris* rises; in both which Places a Roughness may be remarked on the Surface of the Bone.

On the external Surface of the Cheek-
Holes. bones, one or more small Holes are commonly found, for the Transmission of small Nerves or Blood-vessels from, and sometimes into the Orbit; and on the internal Surface, the Holes for the Passage of the nutritious Vessels of these Bones is very conspicuous. The great Slit at the Outside of the Orbit, may be considered as a Hole common to this Bone, the Sphenoid, Maxillary and Palate Bones.

The Substance of these Bones is
Substance. thick for their Bulk, hard and pretty solid with some *Cancelli*.

The *Ossa malarum* are joined, by
Connexion. their superior and their internal orbital Processes to the *Os frontis*, and orbital Process of the *sphenoid* Bone, by means of the transverse Suture: By their Edge between the internal and inferior orbital Processes, to the *Ossa maxillaria*, by means of what may be termed the *internal orbital* Suture: By their Sides, between the maxillary and inferior orbital Processes, again to the maxillary Bones, by a Suture that may be stiled *external orbital*; and by the zygomatick Process to the *Ossa temporum*, by means of the *sutura zygomatica*.

The Cheek-bones are entire and
Of Infants. fully ossified in all their Parts in Infants.

OSSA MAXILLARIA SUPERIORA are the largest Bones, and constitute the far greater Part of the upper Jaw, which has appropriated the Name of *Maxillaria* to them. Their Figure either conjunctly or separately, is so irregular, that Words can scarce give an Idea of it.

The *Apophyses* of each *Os maxillare* may be reckoned six. *First*, The long Process which rises from its superior and anterior Part, turns still smaller, as it runs upwards to make the Side of the Nose, and from its Situation, one may name it *Nasalis*. At the Root of this a transverse Ridge may be observed within the Nostrils, which supports the anterior superior Edge of the *Os spongiosum inferius*. The *Second* is produced backwards and outwards from the Root of the Nasal Process, and may be called *orbital*, because it forms the lower Side of that Cavity. From this proper orbital Part irregular Risings are extended outwards where this maxillary Bone is to be joined to the Cheek-bone. The Edge of this orbital Process, with the Ridge of the nasal which is continued from it, constitute a considerable Portion of the external Circumference of the Orbit. Behind the orbital Process, a large Tuberosity, or Bulge of the Bone appears, which is esteemed the third Process. On the internal Part of this we often meet with a Ridge, almost of the same Height with that in the nasal Process, which runs transversely, and is covered by a similar Ridge of the *Os palati*, on which the posterior superior Edge of the *Os spongiosum inferius* rests; the convex

convex posterior Part of this Tuberosity is rough, as *Albinus* (a) has remarked, for the Origin of Part of the external *Pterygoid* Muscle, and more internally is scabrous, where the Palate and sphenoid Bones are joined to it. That spongy Protuberance, named *Phatnia* by the *Greeks*, at the lower Circumference of this Bone, where the Sockets for the Teeth are formed, is reckoned the *Fourth*. The *Fifth* is all that horizontal Plate, which forms the greater Part of the Base of the Nostrils and Roof of the Mouth: Its upper Surface, which belongs to the Nostrils, is very smooth, but the other below is arched and rough, for the stronger Adhesion of the Membrane of the Mouth, that is stretched upon it, and in chewing, speaking, &c. is more liable to be separated. The *Sixth* rises like a Spine from the inner Edge of the last, and by this Means forms a small Part of the *Septum narium*.

The Depressions in each *Os maxillares* are, 1. A Sinuosity behind the orbital Process, made by the *temporal* Muscle. 2. Immediately before the same Process, a Pit where the Origin of the *Musculus elevator labiorum communis*, and *Elevator labii superioris*, with a Branch of the fifth Pair of Nerves, are lodged securely. 3. The hollow Arch of the Palate. 4. The semicircular great Notch, or Entry to the inferior Part of the Nostrils, betwixt the Root of the nasal Process and Spine of the palatine *Lamella*. Below this, the Fore-part of the Bone is flattened, sometimes hollowed by the *Musculus depressor*

(a) De Ossib. § 79.

pressor labii superioris. 5. Sockets for the Teeth, by the Greeks called *Bothnia**. Their Number is uncertain, being sometimes more, sometimes fewer, according to the Number of Roots the Teeth have. 6. The *Lacrymal fossa* in the *nasal Process*, which assists the *Os unguis* to form a Passage for the *Ductus lacrymalis*; immediately without which, *Winslow* (a) remarks a small Depression, from which the inferior or lesser oblique Muscle of the Eye has its Origin. 7. The Channel on the upper Part of the great Tuberosity within the Orbit, which is almost a complete Hole; in this a Branch of the superior maxillary Nerve passes. Besides these, the superior Surface of the great Bulge is concave, to receive the under Part of the Eye, and immediately above the transverse Ridge in the nasal Process, a small Hollow is formed by the *Os spongiosum*. In some Subjects, the nasal Process has a small round Pit above the lacrymal Duct, where the small Tendon of the orbicular Muscle of the Eye-lids is inserted. It is this Tendon, and not the Tendon of the larger oblique Muscle of the Eye, which there is a Probability of cutting in the Operation of the *Fistula lacrymalis*.

The *Foramina* of this Bone are two proper, and two common, which *Foramina* are always to be found, besides several others, whose Magnitude, Number, &c. are uncertain. First of the proper is the *Orbiter externus*, immediately below the Orbit, by which the infra-orbital Branch of the second

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Branch

* Βόθρια, ὀλμίσκοι, Alveoli, Fossulae, mortuarii^{as} Frana, Locelli, Cavæ, Præsepiola, Loculamenta.

(a) Exposition Anatomique des Os Sees, § 276.

Branch of the fifth Pair of Nerves, and a small Artery come out, after having passed in the Channel, at the Bottom of the Orbit, described *Numb. 7.* of the Depressions. This Hole is often double, and that when the Nerve has happened to split before it has escaped from the Bone. The *Foramen incisivum*, just behind the Fore-teeth, is the other proper Hole; which at its under Part, is one irregular Hole common to the *Ossa maxillaria*, when they are joined, but as it ascends, soon divides into two, three, or sometimes more Holes, some of which open into each Nostril. Through them small Arteries and Veins, and a Twig of the second Branch of the fifth Pair of Nerves pass, and make a Communication between, or join the lining Coats of the Nose and Mouth. In some Subjects, *Steno's Duct* may be traced some Way on the Side of these Passages next the Nose, and small Orifices may be observed opening into the Mouth. The first common Hole is that which appears at the internal posterior Part of the *Tuberosity* and *Alveoli* of the Teeth, and is formed by a *Fossa* in this Bone, and a corresponding one in the *Os palati*: Through it the palatine Nerve, which is a Branch of the second Branch of the fifth Pair of Nerves runs to the Palate. The other common Hole is the great Slit in the Outside of the Orbit described already, as the second common Hole of the sphenoid Bone.

On the nasal Process, often Holes may be observed for the Passage of Vessels to the Substance of the Bones, and at the back Part of the *Tuberosity*, several *Foramina* are placed for

for the Transmission of Nerves to the Cavity within: But these are uncertain.

All the Body of the *Os maxillare* is hollow, and leaves a large *Sinus*, of *Sinus* kin to those of the *Os frontis* and *Sphenoides*, which is commonly, but unjustly, called *Antrum Highmorianum* *, since it is scarce ever omitted by Anatomists, before *Highmore* (a) was so particular about it. *Vesalius* seems to have a pretty good Title to the Honour of the Discovery of these Cavities, as also of the the *frontal* and *sphenoidal* Sinuses; at least so thought *Fallopious* (b). When the *Os maxillare* is single or separated from all the other Bones of a Skeleton, its *Antrum* appears to have a large Aperture into the Nostrils; but, in a recent Subject, it is so covered at its posterior Part, by the *Os palati*; in the Middle, by the *Os spongiosum inferius*; before, by a strong Membrane, that one, or sometimes two small *Foramina* are only left at the the superior Part, which after a small winding Progress, scarce bigger than a Crow-quill, open into the *Nares*, between the two *Ossa spongiosa*: At the Bottom of this Cavity, we may often observe with *Highmore* (c), some Protuberances, in which the small Points of the Roots of the Teeth are contained. The maxillary *Sinuses* have the same Uses as the *frontal*; and we may remark with *Fallopious* (d), that these Cavities are wanting in Children, as well as the others just now mentioned, when

M. 2

the

* Genæ.

(a) Disquis. Anat. lib. 3. part. 2. cap. 1.

(b) Exposit. de Ossibus, cap. 13, 15.

(c) Disquis. Anat. lib. 3. part. 2. cap. 1.

(d) Observ. Anat.

the Bones are only cellular in those Places, where the *Sinuses* afterwards appear. Between this Cavern and Sockets of the Teeth, often an exceeding thin bony Plate is interposed, which may soon be eroded by any acrid Matter collected in the *Antrum*, of which *Higbmore* (a) gives a remarkable Instance, which naturally leads us on Discovery of the Symptoms of such a Collection, to *Cowper's* (b) Practice of pulling the Teeth, and piercing the *Septum* between the Socket and *Antrum*, in order to procure Evacuation of the collected Matter. The good Success of which Practice we have confirmed to us in several Histories related by the Proposer of it, and by others.

The Substance of the *Ossa maxillaria* is all compact, except the inferior Process, where the Teeth are lodged, which is very spongy.

The *maxillary* Bones are joined above by the Extremity of their nasal Processes to the *Os frontis*, by Means of the transverse Suture; at the Sides of these Processes, to the *Ossa unguis*, by the *lacrymal* Sutures; and to the *Ossa nasi*, by the *lateral nasal* Sutures; by their orbitar Processes, to the *Ossa malarum*, by Means of the *external orbitar* Sutures; by the internal Sides of the Tuberosities, to the *Ossa plana*, by Part of the *ethmoidal* Suture; by the back Part of the Tuberosities, to the *Ossa palati*, by the *Harmoniae* or faint *Suturae palato-maxillares*; by the posterior Edges of their palatine *Lamellæ*, to the *Ossa palati*;

(a) Disquis. Anat. lib. 3. part. 2. cap. 1.

(b) Drake's Anthropolog. nov. Book 3. chap. 10.

palati by Means of the *Sutura palatina transversalis* *; by their nasal *Spines*, to the *Vomer*, by a very slight Suture, which might be called *Spinosa*, or rather a double *Schindylesis*; by their *Sockets*, to the *Teeth* by *Gomphosis*; by the internal Edge of the *Palate-Lamella*, to one another by a Suture, which might be named *Palatina longitudinalis*†; on the upper and Fore-part of which, a Furrow is left for receiving the Cartilage which forms the Partition of the *Nostrils*; and between the Fore-part of the *Nostrils* and *Mouth* to each other by a Suture, which may be named *Mentalis*; and sometimes they are connected to the *Ossa spongiosa inferiora*, by a plain Concretion or Union of Substance.

Thus we see these two Bones form the greater Part of the *Nose* and *Roof* of the *Mouth*, and a considerable Share too of the *Orbit*. They contain sixteen *Teeth*, give Rise to *Muscles*, Transmision to *Nerves*, &c. as above.

Each of the *Ossa maxillaria*, is pretty complete in a new born Child, only the external orbital Process, instead of being scabrous, is hollow with remarkable *Foramina* in it; there seem to be only five *Sockets* for the *Teeth*, of which the two posterior are very large. The *Palate-Lamella* is cribriform about the Middle. The great *Tuberosity* is not formed; and in place of the *Antrum*, there is only an oblong Cavity at the Side of the *Nostrils*.

M 3

OSSA

* Arcuata, Palatina transversa postica.

† Laquearis, Palataria recta.

OSSA PALATI are commonly described as two small square Bones, at the posterior Part of the Palate or Roof of the Mouth, tho' they are of much greater Extent, being continued up the posterior Part of the *Nares* to the Orbit, as *Eustachius* (a) has obscurely painted, *Vidus Vidius* has hinted (b) and delineated (c), and *Winslow* (d) has fully demonstrated. Each Palate-bone may therefore be divided into four Parts, the Square-bone, the Pterygoid Process, nasal *Lamella*, and orbital Process.

The Square-bone is unequally concave, for enlarging both the Mouth and Cavity of the Nose.

The superior Part of its internal Edge rises into a Spine, after the same Manner as the Palate-*Lamella* of the *Os maxillare*, to be joined with the *Vomer*. Its anterior Edge is unequally ragged, for its firmer Conjunction with the Palate Process of the former Bone. The internal Edge is thicker than the rest, and full of unequal prominent Teeth, for its Conjunction with its Fellow of the other Side. And the posterior Side is somewhat in form of a Crescent, and thick for the firmer Connexion of the *Velum pendulum palati*, the internal Point being produced backwards, to afford Origin to the *Musculus Palato-staphylinus* of *Dionis* and *Douglas*. This Square-bone is well distinguished from the *Pterygoid* Process by a perpendicular

(a) Tab. 47. Fig. 1. 3. 6. 7. 8.

(b) De Anat. lib. 2. cap. 2. explicat. Tab. 6.

(c) Tab. 6. Fig. 19.

(d) Memoires de l'Acad. des Sciences 1720.

pendicular *Fossa*, which applied to such another in the *Os maxillare*, forms a Passage for the Palatine-branch of the fifth Pair of Nerves; and by another small Hole behind this, through which a Twig of the same Nerve passes.

The *Pterygoid* Process is somewhat triangular, having a broad Base, and ending smaller above. The posterior Side of this Process has three *Fossæ* formed in it; the two lateral receive the Extremities of the two Plates of the sphenoid Bone that are commonly compared to a Bat's Wing; the middle *Fossa* makes up Part of what is commonly called the *Fossa pterygoidea*; the anterior Side of this palatine pterygoid Process, is an irregular Concave, where it receives the Back-part of the *Tuberositas maxillaris*. Frequently several small Holes may be observed in this triangular Process, particularly one near the Middle of its Base, which a little above communicates with the common and proper Holes of this Bone already taken Notice of.

The *nasal Lamella* is extremely thin and brittle, and rises upwards from the superior Side of the exterior Edge of the Square-bone, and from the narrow Extremity of the *Pterygoid* Process; where it is so weak, and at the same time, so firmly fixed to the *Os maxillare*, as to be very liable to be broke in separating the Bones; and therefore it is, that Authors have failed in their Descriptions of this Bone. From the Part where this *Lamella* rises, it runs up pretty broad on the internal Side of the *Tuberositas maxillaris*, to form a considerable Share of

of the Sides of the *Antrum Highmorianum*, and to close up the Space between the *sphenoid* and the great Bulge of the Maxillary Bone, where there would otherwise be a large Slit opening into the Nostrils, as *Albinus* (a) has well remarked. From the middle internal Side of this thin Plate, a cross Ridge placed on such another of the maxillary Bone is extended; on it, the back Part of the *Os spongiosum inferius* rests; along the outside of this Plate, the perpendicular *Fossa* made by the Palate Nerve is observable.

At the superior Part of this
Orbital Processes. nasal *Lamella*, the Palate Bone divides into two Processes, which I already named *orbital*, between which and the Body of the *sphenoid* Bone, that Hole is formed, which I mentioned as the last of the Holes common to the *sphenoid* Bone. Sometimes this Hole is wholly formed in the *Os palati*, by a bony cross Plate going from the one orbital Process to the other. A Nerve, Artery and Vein belonging to the Nostrils pass here. The largest of the two orbital Processes is the anterior; the anterior Surface of which is contiguous to the back Part of the *Sinus maxillaris*, and its superior Surface appears in the Bottom of the Orbit, behind the posterior Part of the *Os maxillare* and below the *Os planum*. Its posterior Surface is cellular, resembling much the Appearance of the *Cel- lule Ethmoideæ*, to which it is contiguous; it is placed on the Aperture of the *Sinus sphenoidalis*, so as to leave only a round Hole

(a) De Ossib. § 23.

Hole at its superior anterior Part. The other Part of the orbital Process is joined to the internal Side of the superior posterior Part of the *Tuberositas maxillaris*.

The Palate square Part of this Palate Bone and its pterygoid Process *Substance* are pretty firm and strong with some *Cancelli*; but the nasal Plate and orbital Processes are very thin and brittle.

The *Ossa palati* are joined to the *Ossa maxillaria*, by the anterior Edge *Connexion* of the Palate Square-bone, by Means of the *Sutura palatina transversalis*: By their thin nasal *Lamellæ*, and Part of their orbital Processes to the same Bone, by the *Palato-maxillares* Sutures: By their *Pterygoid* Processes, to the *Alæ vespertilionum*, by the *sphenoid* Suture: By the transverse Ridges of the nasal *Lamellæ*, to the *Ossa spongiosa inferiora* by Contact; hence frequently in old Skulls an intimate Union of Substance is found: By the orbital Processes, to the *Ossa plana* and *Celulæ ethmoidæ*, by the *Ethmoid* Suture: To the Body of the *sphenoid* Bone, by the *sphenoid* Suture: And by the internal Edge of the Square-bones to one another, by the *Palatina longitudinalis* Suture.

The Palate-bones form Part of the Palate, Nares, Orbits and *Fossæ pterygoideæ*, and cover Part of the *Sinus maxillares*, *sphenoidales* and *ethmoidei*. *Uses*

These Bones are very complete in a new born Infant, the nasal *Lamella* being thicker and stronger *In Children* than in Adults; but the orbital Process has not the Cells which appear in old Bones.

Where

When we are once acquainted with the History of these Bones, the Reason is evident why the Eyes are so much affected in Ulcers of the Palate, as to be often attended with Blindness, which frequently happens in an ill managed *Lues Venerea*; or why on the other hand the Palate sometimes suffers from an *Ægylops*; as in the Instance related by *Hoffman* (a).

OSSA TURBINATA, or *Ossa turbinate spongiosa inferiora*, are so called from their pyramidal Figure, spongy Texture, without any external smooth firm *Lamella*, and from their Situation at the inferior Part of the Nostrils, towards the Cavity of which they are convex, while on the other Side, which faces the *Antrum maxillare*, they are concave. From their superior straight Edge, contiguous to the *Ossa maxillaria*, two small Processes stand out: The posterior, which is like a Hook, covers some of the *Antrum Highmorianum*; the anterior joins with the *Os unguis*, to make up Part of the *Ductus lacrymalis*. The inferior Edge is a convex Curve, the Middle of which is pendulous, without a Connexion to any Bones; but the posterior Part, which ends in a very acute Angle with the superior Edge, is supported by the transverse Ridge of the nasal *Lamella ossis palati*; and the anterior Extremity, which is broad and ragged, rests on the transverse Ridge of the *Os maxillare*, at the internal Root of the nasal Process.

Beside the two spongy Bones mentioned as Part

(a) Ephemerid. German. Cent. 1 & 2. observ. 135.

Part of the *ethmoid* Bone, and these just now described, *Cowper* (a) mentions two others, one in each Nostril, that are sometimes found situated lower than any of them, and seem to be a Production of the Sides of the maxillary *Sinus* turned downwards. When this third Sort of spongy Bones is found, the middle one of the three in each Nostril is the largest, and the lowest is the smallest. *Santorini* (b) remarks, that there are often several other small Bones standing out into the Nostrils, that from their Shape might also deserve the Name of *Turbinata*, but are uncertain in their Bulk, Situation and Number.

The Names of these Bones sufficiently declare their Substance. Substance.

They are joined to the *Ossa maxillaria palati* and *unguis* in old Subjects, by a firm Union of Substance; Connexion. and as this happens also frequently in People of no great Age, *Santorini* (c) contends that they should be esteemed Part of the Palate-bones.

Their Use is, to straighten the Nostrils, to afford a larger Surface for extending the Organ of Smelling, to cover Part of the *Antra maxillaria*, and to assist in forming the Under-part of the lacrymal Duct, the Orifice of which into the Nose lies concealed by these Bones. Use.

The *Ossa turbinata* are complete even in a new born Infant. In Children.

VOMER,

(a) Drake's Anthropolog. Book 3. Chap. 10.

(b) Observat. Anatomic. cap. 4. § 9.

(c) Observat. Anat. cap. 4. § 7.

VOMER, or Bone resembling a *Vomer*. Plough-share, is the thirteenth of the upper Jaw, without a Fellow, forming the posterior and inferior Parts of the *Septum narium*, and first described as a distinct Bone by *Columbus* (a) and *Fallopins* (b).

The Figure of this Bone is an irregular Rhomboid, the posterior Side of which appears in an oblique Direction at the Back-part of the Nostrils. The superior Side is firmly united to the Base of the *sphenoid* Bone, and to the nasal *Lamella* of the *ethmoid*; and, when it can be got separated, is hollow, for receiving the *Processus azygos* of the *sphenoid*. The anterior Side has a long Furrow in it, where the middle Cartilage of the Nose enters. The lower Side of the *Vomer* is firmly united to the nasal Spines of the maxillary and Palate-bones. These Sides of this Bone are much thicker than the Middle, which is as thin as the finest Paper; by which, and the firm Union or Connexion this Bone has above and below, very seldom it can be separated entire; which I suppose is the Reason why Authors have generally failed in the Description of some of the Parts of this Bone: But when it is examined in a Child, the Mechanism of it much more evidently discovers itself; wherefore I shall examine more particularly all its Parts, as they are to be found in such a Subject.

Its Situation is not always perpendicular, but often inclined, as well as the nasal *Lamella ethmoidea*, to one Side.

Its

(a) De re Anatom. lib. 1. cap. 8.

(b) Observat. Anatom.

Its superior Edge (under which I comprehended the superior and anterior Sides in the former Description) is a convex Arch behind, then becomes straight, as it runs down and forwards; and is composed of two lateral Plates, the Extremities of which have a great Number of small Processes, disposed somewhat like the Teeth of a Saw, but more irregular, and several of them are reflected back. Between these Plates a deep *Fossa* is left, which, so far as the Top of the Curvature, is wide, and has strong Sides, for receiving the *Processus azygos* of the *sphenoid* Bone. Beyond the Arch forwards, the *Fossa* is narrower and shallower gradually to the Point of the Bone, receiving for some Way the nasal *Lamella ethmoidea*, which is so closely united to the *Vomer* by the serrated Fringes piercing into its Substance, as in old People to prevent any Separation; and beyond that, the middle Cartilage of the Nose fills up the *Fossa*. The posterior Edge of the *Vomer*, which appears above the posterior Extremity of the Palate-bones, is broader above; but as it descends forwards, becomes thinner, tho' it is still solid and firm. The inferior Edge of this Bone, which rests on the nasal Spine of the *Ossa palati* and *Maxillaria*, has a small Furrow on each Side of a small middle Ridge, answering to the Spines of the Bones of different Sides, and the Interstice between them. This Edge ends in a Point with the superior.

The Body of the *Vomer* has a smooth Surface, and solid, but thin Substance; and towards its Sides,

N

where

where it is thickest, some *Cancelli* may be observed when the Bone is broke.

It is joined, above, to the *sphenoid* and *ethmoid* Bones, and to the middle Cartilage of the Nose, by *Schindylesis*; below, to the maxillary and Palate-bones, by a double sort of *Schindylesis*.

The *Vomer* divides the Nostrils, enlarges the Organ of Smelling, by allowing Place for expanding the *Membrana narium* on its Sides, and sustains the Palate *Lamellæ* of the *Ossa maxillaria* and *palati*, which otherwise might be in hazard of being pressed into the Nostrils, while the *Vomer* is secured from shuffling to one Side or other by the double *Schindylesis*, with which it is joined to the Bones above and below.

These then are all the Bones which compose the upper Jaw, except the Teeth, which are so much of kin to those of the *Maxilla inferior*, that I rather chuse to make one Description serve for both, in which any Difference observable in either of them shall be remarked, and that after the second Part of the Face is demonstrated, because the Teeth cannot be well understood, until the Case in which they are set is explained: Wherefore we proceed to the

MAXILLA INFERIOR *;

Maxilla inferior. which consists only of one moveable Bone, and sixteen Teeth incased into it.

This Bone is somewhat of the Figure of the Greek Letter ι , situated at the

* $\Gamma\acute{\epsilon}\nu\theta$, $\sigma\acute{\iota}\delta\gamma\omega\nu$, Mandibula, facies.

the lower Part of the Face, so as its convex middle Part is forwards, and its Legs are stretched back. It is commonly *Divided.* divided into the Chin, Sides and Processes. The Chin is the anterior middle Part, the extent of which is marked on the external Surface by the Holes observable there, and internally by the Beginning of an oblique Ridge. Beyond these the Sides appear, and are continued till the Bone, by bending upwards, begins to form the Processes.

On the anterior Part of the Chin, a transverse Ridge appears in the Middle, where the two Pieces of which this *Jaw-bone* formerly consisted are united. *Mentum.* On each Side of this Ridge the *Musculi quadrati*, or *Depressores labii inferioris*, and the *Elevatores labii inferioris Cowperi*, depress the Bone, for a Lodging to themselves: And below these Depressions a small Rising may be remarked, where the *Depressores* commence. On the posterior Surface of the Chin, near the Line that marks the former Division in Children, sometimes three, always two small Protuberances appear. To the uppermost, when it is seen, the *Frenum* of the Tongue is connected. From the Middle the *Musculi genio-glossi* rise, and from the lowest the *Geniohyoidei* have their Origin. Below the last, the *Digastrick* Muscles are inserted into two rough Sinuosities.

At the inferior and anterior external Part of each Side of the lower Jaw, a *Sides;* small Rising may be observed, where the *Depressor labiorum communis* rises; and near the superior Edge a Ridge runs lengthways,

ways, where the *Musculus Buccinator* is inserted. Internally, towards the upper Edge of each Side, another Ridge appears, from which the *Mylo-hyoidei* have their Origin, and to which the internal Membrane of the Gums adheres.

The superior Edge of both Chin and Sides has a great many deep Pits or Sockets, for receiving the Roots of the Teeth. The Number and Magnitude of these Sockets are various, because of the different Number, as well of the Teeth themselves, as of their Roots, in different People. These Sockets in both Jaws, when freed from the Teeth by any means, are some time after filled up with an osseous Network which at last becomes entirely solid, and as smooth as any other Part of the Bone, so that in a great many old Jaws one cannot observe any Vestige of the Sockets: But then the Jaw becomes less, and much narrower, as *Vesalius* (a) observes; and sometimes, when new Teeth are protruded, new Sockets, taken notice of by *Fallopian* (b), are again formed. The inferior Edge of the Chin and Sides is smooth and equal, and is commonly called the Base of the lower Jaw: The Extremities of the Base are termed the *Angles*; the external Surface of each of which has several Inequalities upon it, where the *Masseter* Muscle is inserted; as the internal Surface also has, where the *Pterygoideus internus* is fixed.

The Processes are two on each Side. The anterior sharp thin *Apophyses* are named *Coronoid*. Round these

(a) Anat. Lib. i. Cap. 10.

(b) Observ. Anat.

these the *crotophite* Muscles are inserted. The posterior Processes terminate in an oblong smooth Head, supported by a *Cervix*, and are stiled *Condylloid* *. The Heads, whose greatest Length is transverse, and whose Convexity is turned forwards, are tipp'd with a Cartilage, as the articulated Parts of all other moved Bones are. The Roots and Neck of these *Condylloid* Processes are a little hollow and rough, where the *Pterygoidei externi* Muscles are inserted.

The *Foramina* of the lower Jaw are two on each Side; one at the *Foramina*. Root of the Processes internally, where a large Branch of the third Branch of the fifth Pair of Nerves and an Artery enter, and a Vein returns. From this generally either a small superficial Canal descends, or a Furrow is to be remarked, where a small Branch of the same Nerve is lodged, in its Way to the *Mylo-hyoideus* Muscle and sublingual Gland, as *Palsyn (a)* has justly observed. The other Hole is external, at the Confines of the Chin, where these Vessels come out. The Canal betwixt these two Holes is formed in the Middle of the Substance of the Bone, and is cribriform, or pierced by a great Number of small Holes by which the Nerves and Blood-vessels of the *Cancelli* and Teeth may pass. The Extremity of this Channel is continued a little further than the external Hole at the Chin.

N 3

The

* Articulatorii.

(a) *Anat. Chirurg. traité 5. chap. 6.*

The Surface of the lower Jaw is *Substance.* hard and firm, except at the spongy Sockets, where however it is stronger than the upper Jaw. The internal Substance of it is cellular; but at the Base, where it is most exposed to external Injuries, the solid Sides of it are thick, which Thickness and Solidity of the Bone increases towards the Middle of the Chin, where the *Cancelli* of both Sides communicate.

The lower Jaw generally receives into its Sockets the Roots of sixteen Teeth, by *Gomphosis*; and its *condyloid* Processes, covered with Cartilage, are articulated with the *Ossa temporum*, by what I called the third Species of *Ginglimus*, but in a manner that is not commonly described right: For, as was already narrated in the Description of the temporal Bones, not only the Cavity between the *zygomatic*, *auditory* and *vaginal* Process, but also the adjoining Tubercle at the Root of the *zygomatic* Process of each *Os temporum* is covered with a smooth Cartilage, to facilitate the Motion of the *Condyles*, either in the Cavities or on the Tubercles, as different Occasions require. 'Tis further observable, that an intermediate moveable Cartilage is here placed, which being thin in the Middle, and thick at the Edges, is concave on both Sides; and is so firmly connected by Ligaments to each *Condyle*, as to follow the Motions of the *Condyle*; and is so loosely fastned to the *Os temporum*, as readily to change its Situation from the Cavity to the Tubercle, and to return again; while the com-
mon

mon Ligament of the Articulation affords Space enough for such a Change of Place.

From which View of these Articulations we may easily conceive how the several Motions of the lower Jaw are performed: For while the Teeth of both Jaws coincide, the *Condyles* securely play in the Cavity; but when the inferior Teeth are advanced forward, beyond the Range of the superior, the *Maxilla* rests on the Tubercles, by which the necessary Advancement of this Bone is allowed; and notwithstanding the Change of Place, a firm Axis of Motion is still afforded: Tho' at the same Time it must be granted, that in this straining Position we cannot open our Mouths, unless by a convulsive Action of the Muscles, and then not without some Danger of a Luxation of the *Condyles*, which often happens to old People or Children in yawning. Whence the common Practice of Nurses, in restraining the Jaws of Children from opening too wide in that convulsive Motion, is far from unreasonable. These Cartilages also serve to render the Articulations loose enough for performing the lateral Motions; and therefore, by a quick Succession of the Motions forwards, to one Side, backwards, and then to the other Side, the *Condyles* may be moved in a Circle, which is of good Use in chewing (a).

Here a general Remark may be made, That where-ever such moveable Cartilages are found, either the articulated Bones are of such

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(a) Vid. *Edinburgh Medical Essays*, and *Observ.* Vol. I, Art. II. for a more full Account of this Articulation.

a Figure, or so conjoined and fixed by their Ligaments, that little Motion would be allowed without such Cartilages; or some Motions are necessary to the right Use of the Member, which the Form of the Articulation would not otherwise admit of. This will more fully appear after the other Joints with such Cartilages are described.

In a Child born to the full Time
Of Infants. the lower Jaw is composed of two Bones, connected by a thin Cartilage in the Middle of the Chin which gradually ossifies, and the two Bones intimately unite. In each of these Bones there are five Sockets for Teeth, as in the upper Jaw.

After I have thus described the *Uses.* casement of the Teeth, the Insertion of so many Muscles of the Tongue and of the *Os hyoides*, the Connexion of the Membrane of the Tongue to the maxillary Bone, and the Motions of this Bone, 'tis easy to deduce its Uses, of being a principal Instrument in Manducation, Deglutition and Speech.

The *TEETH* are those hard
The Teeth. white Bodies placed in the Sockets of both Jaws. Their Number is generally sixteen above, and as many below, tho' some People have more, others have fewer.

The broad thick Part of the Teeth,
Base. which appears without the Socket, is the *Base* or Body *. The smaller Processes sunk into the *Maxilla* are the *Roots* or *Fangs*. At the Place where the Base ends, and the

* Corona,

the Roots begin, there is generally a small circular Depression, which some call the *Neck* or *Collar*.

Without the Gums the Teeth are covered with no Membrane, and they are said to have no proper *Periosteum* within the Sockets; but that is supplied by the reflected Membrane of the Gums; which, after a good Injection, may be evidently seen in a young Subject, even when it is dried; and, as *Cowper (a)* has very well remarked, it may be discovered in any Tooth recently pulled, by macerating it in Water. The Adhesion of this Membrane to these Roots is increased by the small Furrows observable on them.

Each Tooth is composed of two Substances; an external *Cortex*, *Substance*. which has no Cavity or spongy Substance for Marrow, and is so solid and hard, that Saws or Files can with Difficulty make Impression on it. This *Cortex* is thickest upon the Base, and gradually, as the Roots turn smaller, becomes thinner, but not proportionally to the Difference of Magnitude observable in the Base and Roots. The Fibres of this Enamel are all in a perpendicular Position to the internal Substance, and are straight on the Base, but at the Sides are arched with the convex Part towards the Roots; so that the Teeth will more strongly resist any Violence from the Compression of a hard Body between the Jaws. Besides which advantageous Texture of their Substance, the spongy Sockets in which they are placed will like.

(a) Anatomy Explicat, tab 92, fig. 7. lit E,

likewise serve better to prevent such an Injury, than a more solid Base would have done. Notwithstanding the great Hardness of this *Cortex*, it is wasted by Manducation. Hence the sharp Edges of some Teeth are blunted and made broad, while the rough Surfaces of others are made smooth and flat.

The internal Substance of the Teeth is Bone, with its Fibres running straight according to the Length of the Teeth; which, when exposed to the Air by the breaking or falling off of the hard *Cortex*, must soon corrupt or be destroyed, as is the Nature of all Bones: And thence carious Teeth are often all hollow within, when a very small Hole only appears externally.

The bony Substance of the Teeth *Channel*. has a Channel formed in its Middle, wherein the Nerves and Blood-vessels of the Teeth are lodged: which they certainly need, being constantly wasted by the Attrition they are subjected to in Manducation, and for their further Growth after they first appear. And it is certain, as *Ingrassias* (a) justly affirms, that they are capable of becoming longer and broader in Adults; which does remarkably happen, when any Tooth of a young Person is taken out: For then the opposite one becomes longer, and these on each Side of the empty Socket turn broader; so that when the Jaws are brought together, it is scarce observable where the Tooth is wanting.

The

(a) De Tumor. cap. 1.

The Vessels are easily traced as long as they are in the large Channel, but *Vessels.* can scarce be observed in their Distribution from that to the Substance of the Teeth of Adults: *Ruyfch (a)* however affirms that he could, after Injection, trace the Arteries into the hardest Part of the Teeth. In Children I have frequently injected the Vessels of the Teeth as far as their Base: And in such as are not entirely ossified, one can with a lucky Injection fill so many Vessels, as to make the Inside of the cortical Part appear perfectly red: This plentiful Supply of Vessels must expose the Teeth to the same Disorders that attack other vascular Parts; and such Teeth as have the greatest Number of Vessels, must have the most numerous Chances of being seized with these Diseases.

Every Root of each Tooth has such a distinct Canal with Vessels and Nerves in it. These Canals in the Teeth with more than one Root, come nearer each other, as they approach the Base of the Tooth, and at last are only separated by very thin Plates, which being generally incomplete, allow a Communication of all the Canals, and frequently one common Cavity only appears within the Base, in which a pulpy Substance composed of Nerves and Vessels is lodged. The Condition therefore of the Nerves here, bears a strong Analogy to that of the cutaneous Nerves which serve for the Sensation of Touching. And seeing the *Cuticula* can be rubbed off or cut without Pain, allows the Nerves to be affected by Heat

(a) Thesaur. 10. num. 27.

Heat or Cold, and transmits acid or austere Liquors, that blunt the Touch considerably, and give an uneasy Sensation at the same time; and that several Substances, notwithstanding this interposed Membrane, do create a painful *Tremor*, by their numerous or frequently repeated Impulses. When, I say, all this is reflected on, the analogous *Phaomena* in the Teeth, which the Ancients disputed so much about, will appear to be of no difficult Solution.

The Entry of the Channels for these Vessels, is a small Hole, to be seen a little to a Side of the extreme Point of each Root; sometimes this Hole is entirely closed up, and consequently the Nerves and Blood-vessels are destroyed, as M. *de la Hire* the younger (*a*) has remarked.

The Teeth are seen a considerable *Formation*. Time in form of *Mucus* contained in a Membrane; afterwards a thin cortical Plate, and some few osseous Layers appear within the Membrane; with a large Cavity filled with *Mucus* in the Middle; and gradually this exterior Shell turns thicker, the Cavity decreases, the Quantity of *Mucus* is lessened, and this Induration proceeds till all the Body is formed, from which the Roots are afterwards produced.

In young Subjects, different Stamina or Rudiments of Teeth are to be observed, one above the other, within the same Socket, the exterior of which hinder ordinarily the interior to make their Way out, while the internal pre-

(*a*) Histoire de l' Acad. des. Sciences, 1699.

prevent the others from shooting their Roots, by which they come to be leis fixed in the Sockets.

Children seldom have Teeth appearing without their Gums when *Shedded*. new born, but when they are two Years old or little more have twenty, and their Number does not increase till about seven Years of Age, when those that first made their Way through the Gums, are thrust out by those that have been formed deeper in the Jaw, and some more of the Teeth begin to discover themselves farther back in the Mouth. About fourteen Years of Age, some more of those that came first out are shedded, and the Number is increased. This Shedding of the Teeth is of good Use; for if the first Teeth had remained, they would have come to be at a great Distance one from another, because the Teeth are too hard in their outer Crust, to encrease so fast as the Jaws do. Whereas both the second Layer, and the Teeth that come out late, meeting, while they are soft, with a considerable Resistance to their Growth in Length, from those situated upon them, will necessarily come out broad, and fit to make that close Guard to the Mouth* we now see they form.

The Teeth are joined to the Sock-*ets* by *Gomphosis*, but are principally *Connected*. fastned there by the Gums, as is evident by their falling out when the Gums are any Way destroyed, or made too spongy, as in the *Scarvy* or *Salivations*; whence several

O

Authors

Authors class this Articulation with the *Sy-far-cosis*.

The Uses of the Teeth are to masti-
vise. cate our Aliment, and to assist our Pro-
nunciation of several Letters.

Tho' these Bones so far agree
Distinguished, in their Structure, yet because of
some Particulars wherein they
differ, they are generally divided into three
Classes, viz. *Incisores*, *Canini* and *Molares*.

The *Incisores** are the four ante-
Incisores. rior Teeth in each Jaw, receiving
their Name from their Office of cut-
ting our Aliment, for which they are excel-
lently adapted, being each formed into a sharp
cutting Edge at their Base, by the Extremity
of their anterior Side turning inwards, while
the posterior Surface is flop'd down and hol-
lowed †; so that they have the Form of
Wedges, and therefore their Power of acting
must be considerably increased, as is demon-
strated in the Mechanicks. Seeing in the
Action of the *Incisores*, a perpendicular Com-
pression is only necessary, without any lateral
Motion, they are not so surely fixed in their
Sockets as the other Teeth are, having neither
so many nor so long Roots, but are only pos-
sessed of one short Stump.

The *Incisores* of the upper Jaw, are broad-
er and longer generally than those of the un-
der Jaw, especially the two middle ones †.

In

* *Ἐλαστοίνοι, τομίνοι, διχαστῆρες κτείνες τομείς, περι-
δίοι, ὀφέες, Risorii, quaterii, primi, primiores, antei-
ores acuti.*

† *Ὀλμίσκοι.*

‡ *Duales.*

In a new born Infant, the outer Shell of the Body of these Teeth *Of Infants.* is only hardened.

Canini *, from the Resemblance to Dogs Tusks, are one of each Side of *Canini.* the *Incisores* in each Jaw: The two superior are called *Eye-teeth*, from the Communication of Nerves which is betwixt them and the Eyes; and the two inferior are named angular or *Wike-teeth*, because they support the Angles of the Mouth.

The *Bases* of the *Canini* are broader than those of the *Incisores*, tho' they are also sloped on the interior Side. They are longer than any other Teeth, and stronger than those of the former Class. The *Canini* of the upper Jaw are the largest and longest, and have the Extremity of their Roots crooked, and so are more firmly secured in their Sockets. Hence it is evident, how well these are adapted, for breaking and bruising solid Bodies, this being a Sort of mix'd Action betwixt cutting and grinding, the proper Offices of the other two *Classes*.

The *Canini* of a Child are formed much in the same Manner as the *Of a Child.* *Incisores* are.

The *Dentes molares* or *Grinders* †, which have got their Name because *Molares* they grind our Food, are generally five in each Side of each Jaw, in all twenty.

Q 2

They

* Κυνόδοντες, Risorii, fractorii, collaterales, collumellares.

† Μυλῖται, γόμφοι, μύλοι, πλατεῖς, φραγῆδες, maxillares, mensales, clavales Buccarum.

They are the broadest Teeth of any, with both Sides equally raised, or near so, but are unequal and scabrous in the Extremity of their Bases, to be better fitted for their Office. The Body of the first is generally the least, and comes nearest to the *Canini* in its Shape. The third is the largest, and the fourth and fifth are next in Magnitude.

Some of the *Molares* have only one Root, others two, three, or four, to prevent their loosening by the lateral Pressure they suffer; and in the upper Jaw, their Roots are commonly more numerous than in the lower, because the superior are more liable to fall out by their Situation and the Structure of their Sockets, as *Galen* (a) has well observed. The Number however of the Roots of each of them is very uncertain, sometimes they are more, sometimes fewer, frequently several Roots are joined together, at other times they are all distinct. The Disposition of such as are distinct is also various; for in some the Extremities of the Roots go out streight, in others they separate, and in others again they are crooked inwards. In general we observe, that the farther back in the Mouth these Teeth are situated, the Number of Roots is greater, and when they are united, we can still distinguish them, by remarking the Number of small Holes at their Points, which determine the Number of Roots the Tooth ought to be reckoned to have.

The cortical Substance at the Base of the *Grinders* is thinner than in any other Teeth.

The

(a) De Offib. cap. 5.

The two Teeth that are placed farthest back in each Jaw, are distinguished by the particular Name of *Dentes sapientiae* *, because they commonly cut the Gums about the twenty first Year of our Age, when the Laws allow People to be *sui juris* and capable to manage their own Affairs.

Dentes sapientiae.

At the Time of Birth, only two *Dentes molares* in each Jaw have begun to ossify, and that at little more than the Base, which has several sharp Points standing out from it.

Of Infants.

From what has been said, the Answers of the following Queries may easily be deduced.

Phenomena.

Why in Children do the *Dentes incisores* first cut the Gums, the *Canini* next, and *Molares* last?

Why do Children shed their Teeth at a certain Age?

Wherefore have these *Temporanei* Teeth no Roots, or very small ones?

How have some People got two Rows of Teeth in one or both Jaws?

Whence arise the new Sets of Teeth which several old People obtain?

Why are not the Gums of toothless old People torn by the hard Sockets in chewing?

Why are the Teeth insensible when slightly filed or rasped?

How come they to be sensible of Heat or Cold,

O 3

* Σωφρονισμός, κερυτμός ὀφθαλμοί. Sensus, intellectus, serotini, aetatem complementes, genuini, moderatores.

Cold, to be set on Edge by Acids, or to give such an uneasy Sensation, when gritty or sandy Substances are rubbed between them?

What is the Reason of some Persons dying convulsed upon rasping or filing down an overgrown Tooth?

What Parts are affected in the Tooth-ach?

Why are the *Dentes molares* most subject to that Disease?

How do the Teeth break and moulder away without any Pain in some People, and not in others?

Whence proceeds the violent obstinate *Hæmorrhagy* which sometimes attends the drawing of Teeth?

Why is it more difficult and dangerous to draw the Eye-teeth than any other?

What makes it impossible frequently to draw *Grinders* without bringing away Part of the Jaw Bone with them, or breaking the Fangs?

Why have small Worms been sometimes found in carious Teeth?

We should now, according to the Division made of the Skeleton, proceed to the Description of the Trunk of the Body; but must first consider a Bone, which cannot well be said to belong to either Head or Trunk; nor is it immediately conjoined to any other, and therefore is very seldom preserved with Skeletons; however it is generally described by Authors after the Bones of the Face. In obedience therefore to the prevailing Method, I shall next examine the Structure of the

*OS HYOIDES**. This Bone

is situated in a horizontal Position, between the Root of the Tongue and the *Larynx*. It is properly enough named *Hyoides*, from the Resemblance it bears to the Greek Letter υ , and may, for a clearer Demonstration of its Structure, be distinguished into its *Body*, *Cornua* and *Appendices*.

The *Body* is the large middle broad Part, convex before, and hollow behind. The convex anterior Surface is divided into two by a sharp Ridge, into the Middle of which the *Mylo-hyoides* Muscles are inserted, and laterally the *Stylo-hyoides* are fixed. The Part of the anterior Surface above this Ridge is horizontal, but pitted in the Middle by the Insertion of the two *Genio-hyoides* Muscles, and a little hollowed more laterally by the *Basio-glossi*. The inferior Part of this anterior Surface is convex, but a little flattened in the Middle by the *Sterno-hyoides*, and pitted more externally by the *Coraco-hyoides*. The posterior Surface of this *Body* of the *Os hyoides* is concave, but situated obliquely, so as to face backwards and downwards: Into this Concavity the *Thyroid* Cartilage is received, when the *Larynx* and this Bone are pulled nearer by the Action of the *Sterno-hyoides* and *Hyo-thyroides*; and to its superior Edge the ligamentous Membrane of the *Epiglottis* and Tongue is fixed.

The

* *Hypophyloides*, *Lambdoides*, $\mu\alpha\epsilon\psi\iota\lambda\omicron\iota\delta\epsilon\varsigma$, $\lambda\alpha\mu\beta\delta\omicron\iota\delta\epsilon\varsigma$, *Os gutturis*, *os linguae*, *os morsus Adami*, *asseffor*, *os laudis*, *Bicornis*.

The *Cornua*† of the *Os hyoides* are stretched backwards from each Side of its Body, where often a small Furrow points out the former Separation; for in younger Subjects the Body and *Cornua* are not one continued Substance, as they come afterwards to be in Adults. These *Cornua* are not always streight, nor of equal Length; their two plain Surfaces stand obliquely, sloping from above outwards and downwards. Into the anterior the *Cerato-glossus* is inserted above, and the *Thyro-hyoideus* Muscle below; and to the posterior Surface the ligamentous Membrane of the Tongue and *Larynx* adheres. The *Cornua* become gradually smaller towards their Extremity where generally a small rounded Tubercle may be observed, from which a movable Cartilage stands out, which is connected to the superior Processes of the *Cartilago thyroidea*.

From the superior Part of the *Appendices*. Conjunctions of the Body of the *Os hyoides* with its *Cornua*, a small Styliform Process rises upwards and backwards on each Side, which are called the *Appendices* *: These are cartilaginous in young Subjects; and in Adults have one or more disjointed Cartilages continued from them, which sometimes in old People ossify. *Ruyssch* (a) says, the Ossification is continued to the temporal Bones in very old People, and joins the *Os hyoides* to them by *Anchylosis*. These terminate in a Ligament that is produced to the *Styloid*

† Crura, Latera inferiora.

(*) Crura superiora, Latera superiora, Ossa graniformia.

(a) Advers. Anat. Dec. 3 § 9.

Styloid Processes of the *temporal* Bones: Into these *Appendices* the *Stylo-hyoides alteri Douglassii* (a) are inserted, and from thence Part of the *Hyo-glossi* take their Rise.

The Substance of the *Os hyoides* is cellular, but covered with a firm external Plate, which is of sufficient Strength to bear the Actions of so many Muscles as are inserted into it.

It is not articulated with any Bone of the Body, except by the Connexion it has, by Means of the Muscles and Ligaments mentioned.

The Use of the *Os hyoides*, is to serve as a solid Lever for the Muscles to act with, in raising or depressing the Tongue, and *Larynx*, or in enlarging and diminishing the Capacity of the *Fauces*.

At the Birth this Bone is in a cartilaginous State, excepting a small Point of Bone in the Middle of the Body, and in each of the *Cornua*.

The second Part of the *Skeleton* mentioned was the *Trunk*, the Description of which I shall next prosecute.

Of the Trunk.

THE TRUNK consists of the TRUNK.
Spine, Pelvis and Thorax. Divided.

The SPINE* is that long Pile of Bones reaching from the *Condylloid* Processes of the *Occiput*, to the Extremity of

(.) Myograph. chap. 12.

* Πάχις, ράχον, ἀκανθα, ἵερα τέμεγξ, σάλην, Ter-gum, Hominis Carina.

of the Rump. It somewhat resembles two unequal Pyramides, whose Bases are common, or joined together. The Spine is not however streight, but has four or five remarkable crooked Turns; for in descending from its superior Part, it is made to advance forwards by the Force of the Muscles, which pull the Head and superior *Vertebrae* back, being greater than the contracting Power of the Flexors, and thereby it supports the *Oesophagus*, Vessels of the Head, &c. Its middle gives Way backwards to the Heart and Lungs, then it is again bended forwards, to support the *Viscera* of the *Abdomen*; afterwards a second Time turns back for the Enlargement of the *Pelvis*; and, lastly, is reflected forwards for sustaining the last great Gut. We should however observe, that notwithstanding this crooked Figure of the Spine, it is so contrived, that the Center of Gravity of all that Part of it which sustains any considerable Weight, falls on the Middle of the common Base.

The *Spine* is commonly divided into *Divided.* to *true* and *false Vertebrae*, the former constituting the superior long Pyramid with its Base inferior, while the *false Vertebrae* make the inferior shorter Pyramid, whose Base is superior.

TRUE VERTEBRÆ* are *True Ver-* the twenty four superior Bones of *tebrae.* the *Spine*, on which the several Motions of the Trunk of our Bodies are performed, from which Use they have justly got their Name.

Each

* Στροφαῖς, στροφύλλες, Spondyli, ossa orbiculata; ossa vertebrata, verticula.

Each of these *Vertebrae* is composed of its Body and Processes.

The Body is the thick spongy anterior Part, which is convex before, concave *Bodies.* backwards, horizontal and plain in most of them above and below; their anterior and posterior Surfaces having several remarkable Holes made in their thin external Plate, both for the firmer Connexion of the Ligaments, and for the Passage of Vessels into their cellular Substance.

Between these Bodies of each two adjoining *Vertebrae*, a Substance between the Nature of Ligament and *Cartilages.* Cartilage is interposed; which is composed of concentrical curve Fibres, the exterior of which are the most solid and hardest, while those in the Centre, are very soft and full of a glairy Liquor, and therefore this Substance was not improperly called by the Ancients *Ligamentum mucosum*: This is firmly fixed to the horizontal Surfaces of the Bodies of the *Vertebrae*, and therefore not only allows these Bones to recede from each other, and to be prest closer together without breaking, but serves to connect them, in which it is assisted by a strong membranous Ligament, which lines all their concave Surface, and by still a stronger Ligament that covers all their anterior convex Surface. This last it is, that *Blancard* (a) assures us he discovered to consist of two Rows of tendinous *Fibres*, decussating each other in Form of X, so as to be alternately disposed through all the *Vertebrae*, i. e. the 1, 3,

5,

(a) Anat. reformat. cap. 32.

5, 7, &c. should be similar, and the 2, 4, 6, 8, &c. distinct from the first Class, but alike among themselves.

We may lay down as a general Rule, notwithstanding some Exceptions, that the *Bodies* of the *Vertebrae* are smaller and more solid above, but as we reckon downwards, appear larger and more spongy, and that the Cartilages between them are thick, and the surrounding Ligaments strong in Proportion to the Largeness of the *Vertebrae*, and to the Quantity of Motion they are to perform: By which Disposition the greater Weight is supported on the broadest best secured Base, and the Middle of our Body is allowed a large and secure Motion, which is of considerable Benefit to us.

From each Side of the Body of each *Processes.* *Vertebra*, a bony Bridge is produced backwards and to a Side; from the *Oblique.* posterior Extremity of which, one slanting Process rises and another descends; the smooth, and what is generally the flattest Side of each of these four Processes, which are called the *oblique**, is covered with a smooth Cartilage, and the two inferior oblique Processes of each *Vertebra* are fitted to, and articulated with, the two superior or ascending oblique Processes of the *Vertebra* below.

From between the superior and *Transverse.* inferior oblique Process of each Side, the *Vertebra* is stretched out laterally in Form of a Process, that is universally named *Transverse*.

From

* *Articulatorii, minimi*

From the posterior Roots of the two oblique and of the transverse Process of *Spinal*, each Side, a broad oblique bony Plate is extended backwards, where these meet the seventh and last Process of the *Vertebrae* takes its Rise and stands out backwards; this being generally sharp-pointed and narrow edged, has therefore been called *Spinal Process*, from which this whole Chain of Bones has got its Name.

Besides the common Ligament which lines all the interior Surface of these Processes, as well as of the Bodies, there are particular Ligaments that connect the Processes of each two contiguous *Vertebrae*.

The Substance of the Processes is considerably stronger and firmer *Substance* than that of the Bodies of the *Vertebrae*, having a thicker external Plate, and without so many large Holes made in it.

The seven Processes considered conjunctly, as forming the posterior *Foramina* Shares of the *Vertebrae*, are hollow at their anterior middle Part; which Concavity joined with that at the posterior Part of the Bodies, makes one great *Foramen*, which answers to such another in the *Vertebra* above and below: Therefore the *Foramina* of all the *Vertebrae* taken together, form a long great Conduit*, which is widened or straitened in Proportion to the Size of the *Medulla spinalis* which it contains.

In the lateral Bridges, which join the Bodies to the Processes of each *Vertebra*, a semicircular

P lar

* *ἰσθμὸς, στέγος, σωλήν, Canalis,*

lar Notch is observable both above and below; which, exactly corresponding with others in the contiguous Bones, when the *Vertebrae* are joined, form a round Hole in each Side, between each two *Vertebrae*, through which the Nerves that proceed from the *Medulla spinalis* and the Blood-vessels pass.

The Articulations then of these *Articulations*. true *Vertebrae* are plainly, double; for their Bodies are joined by *Synchondrosis*, and their oblique Processes are articulated by the third Sort of *Ginglymus*. Hence it is evident that their Center of Motion is altered in different Positions of the Trunk: For when we bow forwards, the superior moved Part bears entirely on the Bodies of the *Vertebrae*; if we bend back, the oblique Processes support the Weight; if we recline to one Side, we rest upon the oblique Processes of that Side and Part of the Bodies; if we stand erect, all the Bodies and oblique Processes have their Share in our Support..

Hence it follows: 1. That be-
Advantages. cause the Joints, of which the Spine is composed, are so numerous, the *Medulla spinalis*, Nerves, Blood-vessels, &c. are not liable to such Compression and Overstretching in the Motion of the Trunk of the Body, as they would be otherwise; since several *Vertebrae* must be concerned in every Motion of the Spine, and therefore a very small Curvature is made at the Conjunction of any two *Vertebrae*. 2. That an erect Posture is the surest and firmest, because the Surface of Contact of the *Fulcra* is largest, and the Weight is most perpendicular to them. 3. That the
Muscles

Muscles which move the Spine act with greater Force in bringing the Trunk to an erect Posture, than in drawing it to any other: For in bending forwards, back, or to a Side, the Muscles which perform any of these Actions are nearer the Centers of Motion; consequently the Lever, with which they act, is shorter, than when the Center of Motion is on the Part of the *Vertebra* opposite to that where these Muscles are inserted, which is the Case in raising the Trunk. This is extremely necessary, since in the Deflexions of the Spine from a perpendicular Bearing, the Weight of the Body soon inclines it which way we design; whereas in raising us erect, this great Weight must be more than counteracted. 4. In calculating the Force exerted by the Muscles which move the Spine, we should with *Borelli* (a) and *Parent* (b) always make allowance for the Action of the Cartilages between the *Vertebrae*, which must, in every Motion from an erect Posture, be stretched in one Side, and compressed on the other, to both which they will resist; whereas in raising the Trunk, these Cartilages will assist by their springy Force. 5. We are hence naturally led into the Reason of the *Phænomenon* observed by Mr. *Wasse* (c), That our Height of Stature is increased in the Morning, and diminished at Night: For the intermediate Cartilages of the *Vertebrae* pressed all Day long by the Weight of our Body, in the Evening become more compact and thin; but when in the Night they

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are

(a) De motu animal. pars 1. schol. ad Propos. 58.

(b) Histoire de l'Acad. des Sciences 1702.

(c) Philosoph. Transact. N^o. 383. p. 87.

are relieved from this Pressure, they again expand themselves to their former Thickness; and seeing the Bulk of any Part must vary according to the different Distension or Repletion of the Vessels composing it, we may understand how we become taller after a plentiful Meal, and decrease after Fasting or Evacuations, which Difference the *Abbé Fontenue* (a) has proved to depend mostly, if not solely on the different Thickness of these Cartilages.

6. From the different Articulations of the Bodies and oblique Processes of the *Vertebræ*, and the different Strength of the Ligaments, it is plain that they are formed so as to allow a much larger Motion forwards than backwards; this last being of much less Use, and might be dangerous by overstretching the large Blood-vessels that are contiguous to the Bodies of the *Vertebræ*.

The *Vertebræ* at the ordinary Time of Birth consist of three bony Pieces, connected by Cartilages; to wit, the Body, which is not fully ossified; and a long curved Bone of each Side, on which we see a little Share of the bony Bridge, the oblique Processes complete, the beginning transverse Processes, and the oblique Plate, but no spinal Process; so that the Teguments might be in no Danger of being hurt by the sharp Extremities of these spinal Processes, as they would be, if there were any such sharp bony Processes, while a Child is in the bended Posture it remains in in the Womb, nor by the Pressure which it undergoes in the Birth.

From

(a) Histoire de l'Acad. des Sciences 1725.

From this general Mechanism of the Spine, an Account is easily deduced of all the different preternatural Curvatures the Spine is capable of: For if one or more *Vertebrae* are of unequal Thickness in opposite Sides, the Spine must be reclined over to the thinner Side; which now sustaining the greatest Share of the Weight, must still be more compressed, consequently hindered from extending itself in proportion to the other Side, which, being too much freed of its Burden, has Liberty to enjoy a luxuriant Growth. The Causes, on which such an Inequality of Thickness in different Sides of the *Vertebrae* depend, may vary: For either it may be owing to an Overdistension of the Vessels of one Side, and from thence a preternatural Increase of the Thickness of that Part; or, which more commonly is the Case, it may proceed from an Obstruction of the Vessels, by which the Application of proper Nourishment to the bony Substance is hindered, whether that Obstruction depends on the faulty Disposition of the Vessels or Fluids, or if it is produced by an unequal mechanical Pressure, occasioned by a paralytick Weakness of the Muscles and Ligaments, or by a spasmodic Overaction of the Muscles on any Side of the Spine, or by a Person's continuing long, or putting themselves frequently into any particular Posture declining from the erect Posture: In all these Cases one common Effect will follow, to wit, the *Vertebrae* turn thick on the Side where the Vessels are free, and remain thin on the other Side where the Vessels are straitned or obstructed. Whenever any mor-

bid Curvature is thus made, almost necessarily a second Turn, but in an opposite Direction to the former, must be formed. Both because the Muscles on the convex Side of the Spine being stretched, must have a stronger natural Contraction to draw the Parts to which their Extremities are fixed, and that the Patient will make Efforts to keep the Center of Gravity of his Body perpendicular to its Base, that the Muscles may be relieved from a constant violent contractile State, which always creates Uneasiness and Pain.

When once we understand how these crooked Spines are produced, there will be little Difficulty in forming a just Prognosis of our Patient's Disease, and a proper Method of Cure may be contrived, which must vary as to the internal Medicines, according to the different Causes on which the Disease depends; but one general Indication must be pursued by Surgeons, which is to counteract the bending Force, by increasing the Compression on the convex Part of the Curvature, and diminishing it on the concave Side. The Manner of executing which in particular Cases must be very different, and requires a very particular Examination of the Circumstances both of the Disease and Patient. In many such Cases I have found some simple Directions as to Postures in which the Patients Body should be kept, of very great Advantage.

Hence also it is easy to deduce the Reason of old People generally bowing forwards, and at last being incapable to raise their Spine erect; since the Cartilages shrivel in becoming more solid: And as this must happen most and soonest

Soonest where these Gristles are least stretched and extended, therefore this Curvature is generally first most remarkable in the *Vertebrae* of their Back, or they become round-shoulder'd.

Tho' the *true Vertebrae* agree in the general Structure which I have hitherto described, yet because of several Specialities proper to a particular Number, they are commonly divided into three Classes, *viz. Cervical, Dorsal and Lumbar.*

The *Cervical* * are the seven superior *Vertebrae*; which are easily distinguished from the rest by these Marks. They are all, except the first, of near an equal Breadth. Their Bodies are smaller and more solid than any others, and flattened on the Fore-part, to make place to the *Oesophagus*; or rather this flat Figure is owing to the Pressure of that Pipe, and to the Action of the *longi Colli* and anterior *recti* Muscles. The posterior Surface, which is also flat, is generally rough, or has small Processes rising from it, where the Ligaments are fixed. The superior Surface of the Bodies of each *Vertebra* is made hollow, by a slanting thin Process being raised on each Side; and the inferior Surface is also excavated, but in a different Manner from the former; for the posterior Edge is raised a little, and the anterior is produced a considerable Way. Whence we see how the Cartilages between those Bones will be more firmly connected,

* Τράχηλος, αὐχὺς, *Colli*,

nected, and the Articulation of any two *Vertebrae* will be more secure.

The Cartilages between these *Vertebrae* are thicker, especially in respect of their Bulk, than those belonging to the *Vertebrae* of the *Thorax*, because of the larger Motion that is allowed here; and they are thickest at their Fore-part, which is one Reason of the *Vertebrae* advancing forward as they descend.

The oblique Processes of these Bones of the Neck more justly deserve that Name than those of any other *Vertebrae*. They are situated slanting, the superior Processes having their smooth and almost flat Surfaces facing obliquely backwards and upwards, and the inferior oblique Processes with these surfaces facing obliquely forwards and downwards.

The transverse Processes of these *Vertebrae* are framed in a different Way from those of any other Bones of the Spine: For besides the common Process rising from between the oblique Processes of each Side, there is a second that comes out from the Side of the Body of the *Vertebrae*; and the two, after leaving a circular Hole for the Passage of the cervical Artery and Vein, being united, are considerably hollowed at their upper Part, with rising Sides to protect the Nerves that pass in the Hollow; and at last each Side terminates in a tuberculous Point, for the Insertion of Muscles.

The spinal Processes of these cervical Bones stand pretty straight backwards, are shorter than those of

of any other *Vertebrae*; and are forked or double at their Extremity; and hence allow a more convenient Insertion to the Muscles, and a larger Motion backwards.

The Holes between the bony cross Bridges, for the Passage of the Nerves from the *Medulla spinalis*, have their largest Share formed in the lowest of the two *Vertebrae*, to which they are common.

The Substance of the cervical *Vertebrae*, especially of their Bodies is not so porous or tender as of the other two Classes.

So far the cervical *Vertebrae* agree in their general Character- *Distinguished.* isticks, but still have some particular Differences, which oblige us to consider them separately.

The first, from its Use of supporting the globular Head, has got the Name of *Atlas* *; and by several Authors is called *Epistrophe*, from the Motion it performs on the second.

The *Atlas*, contrary to all the other *Vertebrae* of the Spine, has no Body; but instead of it there is a bony Arch: In the anterior convex Part of which, a small Rising appears, where the *Musculi longi colli* are inserted; and on each Side of this Protuberance a small Cavity may be observed, where the *Recti interni minores*, commonly (tho' wrongously) ascribed to Cowper, take their Rise. The superior and inferior Parts of the Arch are rough and unequal, where the Ligaments that connect this *Vertebra* to the *Os occipitis* and second *Vertebra*

* Ἀττάλα.

bra are fixed. The posterior Part of the Arch is concave, smooth, and covered with a Cartilage in a recent Subject, to receive the Tooth-like Process of the second *Vertebra*. This Hollow makes the Passage for the *Medulla spinalis* seem much larger in this *Vertebra* than in any other. On each Side of this Concavity a small rough Sinuosity may be remarked, where the Ligaments going to the Sides of the Tooth-like Process of the following *Vertebra* are fastned; and on each Side a small rough Protuberance and Depression is observable, where the transverse Ligament, which secures the Tooth-like Process in the Sinuosity, is fixed, and hinders that Process to injure the *Medulla spinalis* in the Flexions of the Head.

The *Atlas* has no more spinal Process than Body; but instead of it there is a large bony Arch, that the Muscles which pass over this *Vertebra* at that Place, might not be hurt in extending the Head back. On the posterior and superior Part of this Arch there are two Depressions, where the *Recti postici minores* take their Rise; and at the inferior Part are two other Sinuosities, into which the Ligaments which connect this Bone to the following are fixed.

The superior oblique Processes of this *Atlas* are large and hollow, rising more in their external than internal Brim; by which their Articulations with the *Condylloid* Processes of the *Os occipitis* are firmer; for, as I remarked from *Galen* (a) in the Description of these *Condyles*, they

(a) De usu partium, lib. 12. cap. 7.

they cannot slip to either Side; and then this Protuberance serves to defend the *Fossa* or Channel formed behind the external and posterior Part of each of them, in which the vertebral Arteries make the circular Turn, as they are about to enter the great *Foramen* of the occipital Bone, and where the tenth Pair of Nerves go out. The inferior oblique Processes are large, extended from within outwards and downwards, and are slightly hollowed: So that this first *Vertebra*, contrary to the other six, receives the Bones with which it is articulated both above and below.

The transverse Processes are not much hollowed or forked, but are longer and larger than of any other *Vertebra Colli*, to serve for the Origin and Insertion of several Muscles. Those of the Muscles fixed to the transverse Processes that serve to move this *Vertebra* on the second, gain a considerable Lever to act with, by the Distance which each of these long Processes make from the *Axis* of Revolution.

The *Condyles* of the *Os occipitis* move forwards and backwards in the superior oblique Processes of this *Vertebra*, by means of their double *Arthrodia*, which makes what I called the third Species of *Ginglymus*; but very little Motion can here be allowed to either Side, and there must be still less circular Motion, which the *Head* obtains principally by the Circumvolution of the *Atlas* on the second *Vertebra*.

In new born Children this *Vertebra* has only the two lateral Pieces *Of Infants.* ossified, the anterior Arch, which it has instead of a Body, being cartilaginous.

The second *Vertebra colli* is called
 2. *Dentata*. *Dentata*, from the Tooth-like Pro-
 cess on the superior Part of its Bo-
 dy. Some Authors call it *Epistrophe*; but im-
 properly, since this Designation is only ap-
 plicable to the first, which moves on this as on
 an Axis.

The Body of this *Vertebra* is somewhat of
 a pyramidal Figure, the inferior Part being
 large, and produced, especially at its Fore-
 side, to enter into a Hollow of the *Vertebra*
 below; while the superior Part has a square
 Process, with a small Point standing out from
 it. This it is that is imagined to resemble a
 Tooth*, and has given Name to the *Verte-
 bra*. The anterior Surface of this Process is
 cylindrical, smooth, and covered with a Car-
 tilage, where it plays in the Hollow of the an-
 terior Arch of the first *Vertebra*. The poste-
 rior Surface is much the same Way disposed,
 for moving on the cross Ligament, which is
 cartilaginous in the Middle. From the Sides
 of the *Processus dentatus*, the Ligaments go off
 to fix it to the first *Vertebra*; and from its Point
 a strong one is sent out to the *Os occipitis*. Im-
 mediately below the two lateral Ligaments a
 Sinuosity may be observed on each Side, where
 the first vertebral Nerves escape.

The superior oblique Processes of this *Ver-
 tebra dentata* are large, very near in a horizon-
 tal Position, and slightly convex, to be ada-
 pted to the inferior Processes of the first *Ver-
 tebra*. A moveable Cartilage is said by some
 Authors to be interposed between these ob-
 lique

* Conoides, Pyrenoides, Odontoides,

lique Processes of the first and second *Vertebra*; but I could never find it. The inferior oblique Processes of this *Vertebra dentata* answer exactly to the Description given of those common to all the cervical *Vertebrae*.

The transverse Processes differ from those of the other cervical *Vertebrae* in this, that they are shorter, very little hollowed at their superior Part, and not forked at their Extremities; and that the Canals through which the cervical Arteries pass, are about the middle Substance of the Process reflected outwards, so as the Course of these Vessels may be directed towards the transverse Processes of the first *Vertebra*; which are further produced, and therefore make a Turn of the Arteries necessary: But if this had been any where in such a moveable Part as the Neck is, and the Artery not defended by a Bone, and fixed to that Bone, scarce a Motion could be performed without the utmost Hazard of Compression, and a Stop put to the Course of the Liquids, with all the Train of its ill Consequences. Hence we observe this same Mechanism several times made use of, when there is any Occasion for a sudden Curvature of a large Artery. This is the third remarkable Instance of it we have seen: The first was the Passage of the *Carotides* through the *Ossa temporum*; and the second was that lately described in the vertebral Arteries, turning round the oblique Processes of the first *Vertebra*, to come at the great *Foramen ossis occipitis*.

The spinal Process of this *Vertebra dentata* is thick, strong and short, to give sufficient Origin to the *Musculi recti majores*, and

Q

obliqui

obliqui inferiores, and to prevent the Contusion of these Muscles in pulling the Head back.

This second *Vertebra* consists at *In children.* the Birth of four bony Processes ; for besides the three which I already mentioned as common to all the *Vertebrae*, the Tooth-like Process of this Bone is begun to be ossified in its Middle, and is joined as an Appendix to the Body of the Bone. Whence we may deduce one good Reason, why Midwives ought to apply Stay-bands to keep the Heads of new born Children from falling too far backwards, till the Muscles attain Strength enough to be able to prevent that dangerous Motion.

When we are acquainted with the *Motion.* Structure and Articulation of the first and second *Vertebrae*, and know exactly the Strength and Connexion of their Ligaments, there is no Difficulty in understanding the Motions that are performed upon or by the first, tho' this Subject was formerly Matter of hot Dispute among some of the greatest Masters of Anatomy. 'Tis none of my Purpose at present to enter upon a Detail of the Reasons advanced by either Party, but to explain the Fact as any one may see it who will remove the Muscles, which in a recent Subject hinder the View of these two Joints, and then will turn the Head into all the different Positions it is capable of. This done, he will observe the Head to move forwards and back on the first *Vertebra*, as was already said ; while this *Atlas* performs the *Circumgyratio* upon the second *Vertebra*, the inferior oblique Processes of the first *Vertebra* shuffling easily in a circular

cular way on the superior oblique Processes of the second, and its Body or anterior Arch having a Rotation on the Tooth-like Process, by which the perpendicular Ligament that is sent from the Point of the Tooth-like Process to the occipital Bone is twisted, while the lateral Ligaments that fix the *Processus dentatus* to the Sides of the first *Vertebra* are very differently affected, for the one upon the Side towards which the Face is turned by the *Circumgyratio* is much shortned and lax, while the opposite one is stretched and made tense, and yielding at last no more, prevents the Head from turning any further round on this *Axis*, so that these lateral Ligaments are the proper *Moderators* of the *Circumgyratio* of the Head here, which must be larger or smaller as these Ligaments are stronger or longer, and more or less capable of being stretched. Besides this Revolution on this *Axis*, the first *Vertebra* can move a small Way to either Side, but is prevented from moving backwards and forwards, by the anterior Arch of the first *Vertebra*, and by the cross Ligament which is closely applied to the Tooth-like Process. The Motion forwards here would have been of very bad Consequence, as it would have brought the Beginning of the *Medulla spinalis* upon the Point of the Tooth-like Process.

The Rotatory Motion of the Head is of great Use to us on many Accounts, by allowing us so quickly to apply our Organs of Sense to Objects, and the *Axis* of Rotation was altogether proper to be here; for if it had been at a greater Distance from the Head, the Weight of the Head, if it had at any time been

removed from a perpendicular Bearing to the small very moveable Joint, and thereby had acquired a long Lever, would, at every Turn inconsiderately performed, have broke the Ligaments to Pieces; or these Ligaments must have been formed much stronger than could well have been connected to such small Bones: Neither cou'd this circular Motion be performed without Danger on the first *Vertebra*, because the immoveable Part of the *Medulla oblongata* is so near, as at each large Turn the Beginning of the *Medulla spinalis* would have been in danger of twisting, and suffering by the Compression this would make on its tender Fibrils. On the Whole, we may be convinced, that the quick circular Motion of our Head is of good Use to us; and that this second *Vertebra* of the Neck is altogether proper, both by its Structure and Situation, for being the Axis on which that Motion is to be performed.

But then I must take notice that the lateral, or as I called them the *Moderator* Ligaments, confine the Motion of this Joint so much, that tho' it may serve us in several Occasions, yet we often require to turn our Faces so far round as this Joint cou'd never allow, without the greatest Danger of immediately twisting the spinal Marrow too much, and also of the oblique Processes of the *Vertebra* being luxated, therefore in the large Turns of our Face backwards, we increase the Rotation by a little Assistance from each of the *Vertebrae* of the Neck, from the *Vertebrae* of the Loins, and from most of the Joints of the lower Extremities. This Combination of a great many

Joints

Joints towards the Performance of one Motion is also to be observed in several other Parts of the Body; notwithstanding such Motions being generally said to be performed by some one Joint only.

The third *Vertebra* of the Neck is by some called *Axis*; but this Name 3. *Axis*. is given without any Reason to this third *Vertebra*, while it might be applied very properly to the second. This third and the three below have nothing particular in their Structure, but all their Parts come under the general Descriptions formerly given, each of them being larger as they descend.

The seventh * *Vertebra* of the Neck comes near to the Form of those of the 7. Back, having the upper and lower Surfaces of its Body less hollow than the others, the oblique Processes are more perpendicular, neither spinal nor transverse Processes are forked. This seventh and the sixth *Vertebrae* of the Neck have the Hole in each of their transverse Processes more frequently divided by a small cross Bridge, that goes between the cervical Vein and Artery, than any other *Vertebrae*.

The twelve *Dorsal* * may be distinguished from the other *Vertebrae* *Dorsal*. of the Spine, by these proper Characteristics. Their Bodies are of a *Bodies*. middle Size, betwixt those of the Neck and Loins; are more convex before than either of the other two Sorts, and flattened

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late-

* Atlas quibusdam, maxima, magna Vertebra, prominens.

* Θάλασσαν, μετατρέψας, νάτε, υποτεταχίλις, Αντί-βραχι, pectoris, tergi.

laterally by the Pressure of the Ribs, which are inserted into small Cavities formed in their Sides. This Flatning on their Sides, which makes the Figure of these *Vertebrae* near an half Oval, is of good Use, as it affords a firmer Articulation to the Ribs, allows the *Trachea arteria* to divide at a smaller Angle, and the other large Vessels to run secure from the Action of the vital Organs. The posterior Part of these Bodies is more concave than in any of the other two Classes. Their superior Surfaces are all horizontal, with their Edges tipped with *Epiphyses*, which *Fallopins* (a) alledges are only some Parts of the intervening Ligaments become bony. The Cartilages interposed between the Bodies of these *Vertebrae* are thinner than in any other of the true *Vertebrae*, and contribute to the Concavity of the Spine here at its Fore-part, by their being thinnest near the anterior Edge of the *Vertebrae*.

The *oblique* Processes are placed *Processes*. almost perpendicular, the superior slanting very little forwards, and the inferior as much back. Neither they, nor the *oblique* Processes of the Bones of the Neck, have as much Convexity or Concavity as is worth remarking. At their Roots a small Roughness is observable, where the Ligaments that surround their Articulations are inserted; and on the posterior Surface of the Bone, between the Processes of opposite Sides, several sharp little Processes stand out, where strong Ligaments are fixed.

The *transverse* Processes of the *dorsal Vertebrae*.

(a) Observat. Anatom.

brae are long, thicker at their Extremity than in the Middle, and turned obliquely backwards, which may be owing to the Pressure of the Ribs, the Tubercles of which are inserted into a Depression near the Extremity of these Processes.

The spinal Processes are long, small pointed, and run sloping down; and at the superior Part of their posterior Surface, a small Ridge rises, which is received by a small Channel in the anterior Surface of the spinal Process immediately above, which is connected to it by a Ligament. Hence little Motion can be allowed of here, lest the Heart and Lungs should be disturbed in their Actions.

The Conduit of the *Medulla spinalis* is more circular, but corresponding to the Figure of that Cord, smaller here than in any other *Vertebrae*; and a larger Share of the Holes in the bony Bridges, for the Transmission of the Nerves, is formed in the superior than in the inferior *Vertebra*.

The Bodies of the four superior *dorsal Vertebrae* deviate from the Rule of 1---4, the *Vertebrae* becoming still larger as they descend, for the first of these four is the largest, and the other three inferior gradually become smaller, to allow the *Trachea* and large Vessels to divide at smaller Angles.

The two uppermost *Vertebrae* of the Back, instead of being very prominent forwards, are flattened by the Action of the *Musculi longi colli* and *recti majores*.

The proportional Magnitude of the two little Depressions in the Body of each *Vertebra* for receiving

the

the Heads of the Ribs, seems to vary in respect to each other, in this Manner; the Depression on the superior Edge of each *Vertebra*, decreases as far down as the fourth, and always after that increases.

The transverse Processes are longer in each lower *Vertebra* to the seventh or eighth, with their smooth Surfaces, for the Tubercles of the Ribs, facing gradually more downwards; but afterwards as they descend become shorter, and the smooth Surfaces are directed more upwards.

The spinous Processes of the *Vertebrae* of the Back become gradually longer and more slanting from the first, as far down as the eight or ninth *Vertebra*, from which they manifestly turn shorter and more erect.

The first * *Vertebra* besides an oblong
1. hollow in its inferior Edge, that assists in forming the Cavity wherein the second Rib is received, has the whole Cavity for the Head of the first Rib formed in it.

The second has the Name of *Axillary* †,
2. without any Thing particular in the Structure of it.

The eleventh ‡ often has the whole
11. Cavity for the eleventh Rib in its Body, and wants the smooth Surfaces on each transverse Process.

The twelfth † always receives the
12. whole Head of the last Rib, and has no smooth

* Λοφία, Gutturalis.

† Μαχαλις, Maxilla.

‡ Ἀρρεπνός, in neutram partem inclinans.

↓ Διαστέγας, præcingens.

smooth Surface on its transverse Processes, which are very short. The smooth Surfaces of its inferior oblique Processes face outwards as the *Lumbar* do. And indeed we may say in general, that the superior *Vertebrae* of the Back come nearer the Resemblance of those of the Neck, while the inferior are liker the *Lumbar*.

The Articulation of these *Vertebrae* of the Back with the Ribs, shall be more particularly considered after the Ribs are described. Only it may be proper now to remark, that the Ligaments which serve that Articulation, assist in keeping the *Vertebrae* more closely connected.

The inferior and last Class of the *True Vertebrae* is the *Lumbar* *, *Lumbar*. which five Bones may be distinguished from any others by these Marks; 1. Their Bodies, tho' of a circular Form at their anterior Part, are somewhat oblong from one Side to the other, which may be occasioned by the Pressure of the large Vessels, and of the *Viscera* contiguous to that Fore-part. The *Epiphyses* on their Edges are larger, and therefore the superior and inferior Surfaces of their Bodies are more concave than in the *Vertebrae* of the Back. 2. The Cartilages between these *Vertebrae* are much the thickest of, any, and render the Spine convex within the *Abdomen*, by their greatest Thickness being anterior. 3. The oblique Processes are strong and deep, those in opposite Sides being almost placed in parallel Planes, the superior, which are concave, facing inwards; and the

* Οσφύς, ἰξύς, ῥοισάν, Renum, Lumborum,

the convex inferior ones outwards, and therefore these *Vertebrae* do plainly receive each other above, and are received below, which is not so evident in the other two Classes already described. 4. Their transverse Processes are small, long, and near erect, for allowing a large Motion to each Bone, and sufficient Insertion to Muscles, and for supporting and defending the internal Parts. 5. Betwixt the Roots of the superior oblique and transverse Processes, a small Protuberance may be observed, where some of the Muscles that raise the Trunk of the Body are inserted. 6. Their spinal Processes are strong, streight and horizontal, with broad flat Sides, and a narrow Edge above and below, this last being depressed on each Side by Muscles. And at the Root of these Edges, we see rough Surfaces for fixing the Ligaments. 7. The large Canal for the *Medulla spinalis* is rather larger here than in the Back. 8. The Holes for the Passage of the Nerves are more equally formed out of both the contiguous *Vertebrae* than in others, but the superior furnishes however the larger Share of it.

Both transverse and spinal Processes of
 3. the middlemost *Vertebra* of the Loins are longest and thickest, and on each Side of that they decrease, so that these Processes of the first * and fifth † are the least, which is very necessary, especially as to the transverse Processes of these two *Vertebrae*, lest if they had been long, they had struck on the Ribs or *Ossa Ilium*

* Νεφρίτης, renalis.

† Αχαλίτης, fulciens.

iliūm, or bruised the interposed Muscles in the Deflexions of the Spine to a Side.

The *Epiphyses* round the Edges of the Bodies of these *Vertebrae* are most raised 4. s. in the two lowest, and consequently make them appear hollower in the Middle, than the others are.

The Body of the fifth *Vertebra* is rather thinner than that of the fourth. The spinal 5. Process of this fifth is smaller, and the oblique Processes face more backwards and forwards, than in any other *Lumbar Vertebra*.

From the whole, we may deduce the Uses of the true *Vertebrae* in these few 5. *uses*. general Heads. To give us an erect Posture; to allow a sufficient and secure Motion to the Head, Neck, and Trunk of the Body on all necessary Occasions; and to support and defend the *Viscera* and other soft Parts.

After considering the Structure of the particular *Vertebrae*, and their mutual Connexion, we may observe in each a solicitous Care taken that they shall with great Difficulty be disjoined; for their Bodies enter either so into each other, as to prevent their being displaced any how, as in the *Vertebrae* of the Neck; or these Bodies are prop'd on all Sides, as these of the *Back* are by the Ribs; or their Surfaces of Contact are so broad, and the Ligaments so strong and firmly connected, as to render the Separation almost impracticable, as in the *Loins*; while the Depth and Articulation of the oblique Processes are exactly proportioned to the Quantity of Motion the other Parts of the Bone will allow, or the Muscles can perform: Yet as these oblique

Secured
from Luxations.

Pro-

Processes are small, and therefore not capable of so secure a Conjunction as the larger Bodies, they may sooner yield to a disjoining Force; but then their Dislocation is not of near so bad a Consequence: For by their being displaced, the Muscles, Ligaments and *Medulla spinalis* are indeed stretched; whereas, when the Body of the *Vertebra* is removed out of its Place, the *Medulla spinalis* must be completely compressed, or entirely destroyed.

The **FALSE VERTEBRÆ** compose the under Pyramid of the *Spine*. They are distinguished from the former justly enough by this Epithet of *False*, because tho' each Bone resembles the true *Vertebra* in Figure, yet none of them partake of their Use of serving in the Motion of the Trunk of the Body, all of them being intimately united, except at one Part where there is a movable Joint; whence the common Division of these false *Vertebrae* into two Bones, *Os sacrum* and *Coccygis*.

OS SACRUM*, is so called from being offered as a dainty Bit in Sacrifice, or rather because of its Largeness in respect of the other *Vertebrae*. This Bone is of an irregular triangular Shape, broad above, narrow below, convex behind, for the advantageous Origin of the Muscles, that move the *Spine* and Thigh back, and concave before, for enlarging the Cavity of the *Pelvis*. In young Subjects, it may be easily separated into five Bones; nay, in Adults, some Vestige

* Ἰερόν, σπονδύλου μεγάλου. Hippocrat. ὑποσπονδύλου
Oribas. Πλάτυν, Latum, Os Clunium, Clavium,

Vestige of this Division is observable on its anterior Surface, and within the great Canal that runs through the Middle of it; but on its posterior Surface and Sides, there are no such evident Marks of a former Distinction; however, we can still determine the several Parts that belong to each of these Bones.

The anterior spungy Part of the *Os sacrum*, analogous to the Bodies of the *Body* true *Vertebrae*, is smooth and flat before, to allow a larger Space for the contained *Viscera*, without any Danger of hurting them; or this flat Figure may be owing to the equal Pressure of these *Viscera*; the back Part of these same Bodies are almost straight without the concave Curve remarked in the *Vertebrae*, because as the Bones of the *Os sacrum* have no such Motion, there is no Occasion for such a large Cavity to lodge the *Medulla spinalis*: Besides, that Cord is now become so small, that it has separated into the Number of Nerves resembling the *Cauda equina*, therefore requires a less Canal. The Bridges between the Bodies and Processes of this Bone, are much thicker, and in Proportion shorter, than the former Class of Bones enjoys. The Strength of these cross Bridges is very remarkable in the three superior Bones, and is well proportioned to the heavy Weight of the Trunk of the Body, which these Bridges sustain in an unfavourable transverse Situation.

The only oblique Processes of the *Os sacrum* are two that appear, one of each Side, standing out from the superior Part of the first Bone. Their plain erect Surface faces backwards, and receives

*Oblique
Processes.*

ceives the inferior oblique Processes of the last Vertebra of the Loins, to which these Processes are connected by a strong Ligament, which rises from a scabrous Cavity round the Root of these Processes, where mucilaginous Glands are also lodged.

The transverse Processes here are *Transverse Processes.* all grown together into one large strong oblong Process of each Side; which, so far as it answers to the first three Bones, is very thick, and divided into two irregular Cavities, by a long perpendicular Ridge. The anterior Cavity has commonly in the recent Subject, a thin cartilaginous Skin covering it, and is adapted to the unequal Protuberance of the *Os Ilium*, and a strong Ligament connects the Circumference of these Surfaces of the two Bones. The posterior Cavity is divided by a transverse Ridge into two, where a cellular Substance, containing generally *Mucus*, and strong Ligamentous Strings that go from this Bone to the *Os Ilium*, are lodged.

The transverse Processes of the two last Bones of the *Os sacrum* are much smaller than the former, and are rough and porous where the *Glutæi maximi* and *Pyramiformes* Muscles have their Origin; and a strong Ligament, that is extended from the *Ossa Ilium* and Tuberosity of the *Ischium*, is fixed.

The spinal Processes of the three uppermost Bones of the *Os sacrum* *Spinal Processes.* appear short, sharp, and near erect, while the two inferior are open behind, and sometimes a little Knob is to be seen on the fourth, tho' generally this fourth is bifurcated

furcated without the two Legs meeting into a *Spine*, in which Condition also the first is often to be seen, and sometimes none of them meet, but leave a *Sinus* or rather *Fossa*, instead of a Canal, as *Verheyen* (a) remarks. From the Sides of these spinal Processes the *Musculus sacer* has its Rise.

The Canal between the Bodies and Processes of this Bone, for the *Cauda Holes equina*, is triangular, and becomes smaller as it descends, as the *Cauda* also does. Below the third Bone this Passage is no more a complete bony Canal, but is open behind, and is only there defended by a strong ligamentous Membrane stretched over it, which, with the Muscles that cover it, and are very prominent on each Side, is a sufficient Defence for the Bundle of Nerves within.

At the Root of the oblique Processes of this Bone, the Notch is conspicuous, by which, and such another in the last *Vertebra* of the Loins, a Passage is left for the twenty fourth spinal Nerve; and in both anterior and posterior Views of the *Os sacrum*, four large Holes appear, in much the same Height of the Bone, as where the Marks of the Union of its several Bones remain. Some of the largest Nerves of the Body pass thro' the anterior Holes; but the posterior are in a good Measure covered by strong Membranes stretched on them, tho' they still transmit larger nervous Filaments than some Authors would have us believe. The two superior of these Holes, especially on the Foreside, are the largest; and as the Bone descends,

R 2

scends,

(a) Anat. Tract. 5. cap. 9.

scends, the Holes turn smaller. Sometimes a Notch is only formed at the lower Part of this Bone, and in other Subjects there is a Hole to be seen, common to this Bone, and the *Os Coccygis*, through which the twenty ninth spinal Nerve passes, and frequently a bony Bridge is formed on the back Part of each Side by a Process sent up from the posterior Part of the *Os Coccygis*, and joined to the little Knobs which the last Bone of the *Os sacrum* has instead of a spinal Process; under this Bridge or *Fugum*, that twenty ninth spinal Nerve runs in its Course to the common Hole just now described.

The superior Surface of the Body of the first Bone resembles the *Vertebrae* of the Loins; but the fifth Bone ends commonly in an oblong Sort of Head, which is somewhat hollow in the Middle.

The Substance of the *Os sacrum* *Substance.* is very spungy, without any considerable solid external Plates, and is perhaps lighter than any other Bone in the Body of the same Bulk; but is secured from Injuries by the thick Muscles that cover it externally, and by the strong ligamentous Membranes that closely adhere to it. As this is one of the most remarkable Instances of this Sort of Defence afforded a soft weak Bone, we may make the general Observation, That wherever we meet with such a Bone, one or other, or both these Defences are made Use of; the first to ward off any Injury, and the second to keep the Substance of the Bone from yielding too easily.

This

This Bone is articulated above to the last *Vertebra* of the Loins, *Articulation.* in much the same Manner as the other *Vertebrae* are, and therefore, the same Variety of Motion may be allowed. The Articulation of the *Os sacrum* at its inferior Part to the *Os Coccygis*, seems well enough adapted for allowing a considerable Motion to this last Bone, was it not much confined by the Ligaments which are produced from the Sides of the articulated Bones, to others which are immoveable. Laterally the *Os sacrum* is join'd to the *Ossa Ilium*, by an immoveable *Synchondrosis*, or what almost deserves the Name of Suture; for the cartilaginous Crust on the Surface of the Bones is very thin, and both their Surfaces are so scabrous and unequal as to be indented into each other. Very often the two Bones grow together in old Subjects, so that I cannot conceive how a Separation should here be made in Child-bearing, without immediate Destruction; or the greatest Inconveniency ever after to the Mother, as we see happened in the Case related by *Ludovicus (a)*, since such is the natural Cohesion of these Bones, that tho' stripped of their Muscles and Ligaments, they are not to be separated with less Force than that of a strong Man assisted by a long Lever.

The Uses of the *Os sacrum* are to serve as the common Base and Support *Uses.* of the Trunk of the Body, to guard the Nerves proceeding from the Extremity of the spinal Marrow, to defend the Back Part of the

R 3

Pelvis,

(a) Ephem. German. Dec. 1. Ann. 2. Obs. 254.

Pelvis, and to afford a sufficient Origin to the Muscles which move the Trunk and Thigh.

The Bones that compose the *Os sacrum* of Infants, have their Bodies separated by a thick Cartilage, and each of these Bones consists of three Pieces joined by Cartilage, as the *Vertebrae* do, the posterior Extremities of the two lateral Pieces, being scarce brought contiguous in any of them.

OS COCCYGIS *, or *Rump-Os Coccygis*. bone, is that irregular Chain of Bones depending from the *Os sacrum*, each Bone becoming smaller as they descend, till the last ends almost in a Point. The posterior Surface of the *Os Coccygis* is convex, and the anterior is concave, from which crooked Pyramidal Figure, this Bone has got its Name, because of the imaginary Likeness it was thought to have to a Cuckow's Beak.

This Bone consists of four several *Divided*. Pieces in People of a middle Age:

In Children very near the whole of it is Cartilage; and in old Subjects, all the Bones are united, and become frequently one continued Bone with the *Os sacrum*.

The highest of the four Bones is the
1. largest, with Shoulders extended farther to each Side than the Extremity of the *Os sacrum*; which Enlargement, should in my Opinion serve as a distinguishing Mark to fix the Limits of either Bone, and therefore, should

* Ὀσσοκύγιον, ὄσσο, Caudæ Os, Spondylium, Os Cuculi.

should take away all Dispute about reckoning the Number of Bones, one or other of these two Parts of the *False Vertebra* is composed of, which must still be kept up, as long as the Numbering five or six Bones in the *Os sacrum*, depends upon the uncertain Accident of this broad-shoulder'd little Bone being united to, or separated from it. The superior Surface of this Bone is a little hollow. From the Back of that bulbous Part called it's Shoulders, a Process often rises up on each Side, to join with the bifurcated Spine of the fourth and fifth Bones of the *Os sacrum*, to form that bony Bridge mentioned in the Description of the former Bone, and sometimes the Shoulders of this first Bone are conjoined to the Sides of the fifth Bone of the *Os sacrum*, to form the Hole common to these two Bones, for the Passage of the twenty ninth spinal Nerve. Immediately below the Shoulders of the *Os Coccygis*, a Notch may be remarked on each Side, where the thirtieth Pair of the spinal Nerves pass. The inferior Part of this Bone is formed into a small Head, which very often is somewhat hollow in the Middle.

The three inferior Bones gradually become smaller, and are very spongy, but are strengthened by a firm strong Ligament which covers them. Their Extremities, by which they are articulated, are formed in the same Manner as the first is.

Between each of these four Bones, except when they are grown together, a Cartilage is interposed, so that their Articulation is something analogous to that of the Bodies of the *Vertebrae* of the Neck; for, as has been above

remarked, the under Extremity of the *Os sacrum*, and of each of the three superior Bones, has a small Head hollowed in the Middle, and the superior Part of all the Bones of the *Os Coccygis* is a little concave, and consequently the interposed Cartilages are thickest in the Middle, to fill up both Cavities by which they connect the Bones more firmly. When the Cartilages ossify, the superior Extremity of each Bone is formed into a Cavity exactly adapted to the round Head of the lower Extremity of the Bone immediately above. From this Sort of Articulation, it is therefore evident, that all of them, while in this Condition, are capable of Motion, of which the first and second, especially this last, enjoys the largest Share.

The inferior Extremity of the fourth Bone terminates in a rough Point to which a Cartilage is appended.

Into the Sides of these Bones of the *Os Coccygis*, the *Coccygæi* Muscles of *Douglas* (a), or rather of *Eustachius* (b) are inserted, and to them the strong Ligaments extended from the *Ossa Ischia* are fixed, and from them a considerable Share of the *Musculi levatores Ani* takes its Origin.

The Substance of these Bones is
Substance. very spongy, and in Children cartilaginous, there being only a Part of the first Bone ossified in a new born Infant, since therefore the *Levatores Ani* have not such a firm Origin, nor the *Intestinum rectum* such

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(a) Myograp. chap. 40.

(b) Tab. 36. No. 45. 20.

strong Support in Children, it would appear no unreasonable Conclusion of *Spigelinus* (a) and *Paaw* (b), that the Weakness and Flexibility of this Part, may be one Cause of Children being more subject to a *Procidencia Ani* than old People.

From the Description of this Bone, we see how little it resembles the *Vertebrae*, since it seldom has Processes, never has any Cavity for *Medulla spinalis*, nor Holes for the Passage of Nerves. And from the Connexion it has by strong Ligaments to the *Ossa Innominata*, we may be convinced, that the Motion it enjoys cannot be to either Side, and is pretty much confined backwards and forwards: Yet as the Ligaments can be stretched by a considerable Force, it is a great Advantage in the Excretion of the *Feces alvinæ*, and much more in Child-bearing, that this Bone should remain moveable, otherwise, as in Women who are old before they are Mothers, the Birth must be difficult and hazardous. *Paaw* (c) assures us from his repeated Experience, that he has seen very great Inconveniencies and Danger from this Bone not being allowed to recede back in the Time of Birth, and as speedy a Delivery after assisting the Head of the Child to push the *Os Coccygis*. Nay *Deventer* (d) seems to put a large Share of the Art of Midwifery on the right Management of this Bone, and boasts of the Rules he lays down for that Operation, as

one

(a) De humani corp. fabric. lib. 2. cap. 32.

(b) De Ossib. pars 2da. cap. 3.

(c) Ibid.

(d) Operat. Chirurg. cap. 27.

one of the greatest Discoveries he had made.

The *Os Coccygis* serves to sustain the *vis*. Extremity of the *Intestinum rectum*; and in order to perform this Office more effectually, it is made to turn with such a Curve forwards, by which also the Bone itself, the Muscles and Teguments are preserved from any Injury when we sit with our Body reclined back.

In the Description of the *Os sacrum* I mentioned its firm Connexion on each Side to the *Ossa innominata*, which, with that Bone and *Os Coccygis*, form the bony Sides of the cylindrical Cavity, which the *Abdomen* is contracted into at its lower Extremity, and universally known by the Name of *PÉLVIS*. I mentioned this as the second of the Parts into which the Trunk of the Body is divided, and therefore, to complete the Description of the bony Part of this Cavity, I shall next consider the Structure of these *Ossa innominata*, notwithstanding I know them accounted by several Anatomists to belong to the *inferior Extremities*.

OSSA INNOMINATA *. The Name of these Bones, tho' of no Import to know their Situation, Structure or Office by, is most commonly used, even by Authors, who have generally been very liberal in bestowing Variety of Names on other Bones; long Use has made it now so familiar, and such a Distinction from all others, as gives no occasion for changing it.

The

* Σκελετων, προσφύσεις, *Sacro conjuncta*.

The *Ossa innominata* are two large broad Bones, that form the Fore-part and Sides of the *Pelvis*, and the inferior lateral Parts of the *Abdomen*. In Children each of these Bones is evidently divided into three; which are afterwards so intimately conjoined, that scarce the least Mark of their former Separation remains: But still however they are described as consisting each of that Number of Bones, to each of which proper Names are given. In obedience therefore to this prevailing Custom, I shall separately describe the *Os Ilium*, *Ischium* and *Pubis*, (for so are the Parts of each *Os innominatum* called,) and shall point out the Parts particular to each, and afterwards consider what is common to any two, or to all three of them.

OS ILIUM *, or Haunch-bone, is the superior broad Bone that reaches about as far down as a transverse Section of one Third of the great *Acetabulum* or Cavity with high Brims, where the Head of the Thigh-bone is received.

The external Side of this Bone is unequally convex, and is called its *Dorsum*; the internal concave Surface is by some (but improperly) named its *Costa*. The superior semicircular Edge, tipped with a Cartilage in the recent Subject, is named the *Spine*, into which the external or descending oblique Muscle of the *Abdomen* is inserted; and from it the internal ascending oblique and the transverse Muscles of the Belly, with the

Glu-

* *Λαγύαν, κενέαν*, Scaphium, lumbare, clunium, clavium, anchas.

Gluteus maximus and *latissimus Dorsi* have their Origin. Winslow. (a) is of Opinion, that it is only the tendinous Crust of all these Muscles, and not a Cartilage, as commonly alleged, that covers this bony Edge. The Extremities of the Spine are more prominent than the Surface of the Bone below them, therefore are reckoned Processes. From the Point of the anterior spinal Process the *Sartorius* Muscle has its Rise, and from the Outside of this Process the *Musculus fascialis* takes its Origin. The Inside of the posterior spinal Process, and of Part of the Spine forward from that, is made flat and rough where the *Sacro-lumbalis* and *longissimus Dorsi* rise. Below the anterior spinal Process another Protuberance stands out, which by its Situation may be distinguished from the former, as Baker (b) has done, by adding the Epithet of *inferior*, where the *Musculus rectus Tibiæ* has its Origin. Betwixt these two anterior Processes the Bone is hollowed, where the Beginning of the *Sartorius* Muscle is lodged safe from external Injuries. Below the posterior spinal Process a second Protuberance of the Edge of this Bone is in like manner observable, which is closely applied to the *Os sacrum*. Under this last Process a considerable large Niche is observable in the *Os Ilium*, which with the strong Ligament that is stretched over from the *Os sacrum* to the *Ischium* of the recent Subject forms a large Hole thro' which the great sciatic Nerve
and

(a) Exposition Anatomique du corps humain traité des Os frais, § 96.

(b) Curs. Osteolog. demonstr. 3.

and the posterior crural Vessels pass, and are protected from any Compression.

The external broad Side or *Dorsum* of the *Os Ilium* is a little hollow to-
Dorsum.
 wards the anterior Part, farther back it is as much raised, then is considerably concave, and lastly it is convex. These Inequalities are occasioned by the Actions of the Muscles that are situated on this Surface. From behind the superior anterior spinal Process, in such Bones as are strongly marked by the Muscles, a semicircular Ridge is extended to the hollow Passage of the sciatic Nerve. Between the Spine and this Ridge the *Glutæus maximus* takes its Rise; then, immediately from above the anterior inferior spinal Process, a second Ridge is stretched to the Niche. Between the two Ridges the *Glutæus medius* has its Origin; and in the Space between the lower Ridge and the *Acetabulum* the *Glutæus minimus* is lodged. On the Outside of the posterior spinal Processes the *Dorsum* of the *Os Ilium* is flat and rough, where the *Musculus pyriformis* rises. The inferior Extremity of this Bone becomes much thicker than any other Part of it, and is formed into a large Cavity with high Brims, to assist in composing the great *Acetabulum*, which shall be considered after all the three Bones that constitute the *Os innominatum* are described.

The internal Surface of the *Os Ilium* is concave in its largest anterior Part, where the internal Iliac Muscle has its Origin, and some Share of the *Intestinum Ilium* and *Colon* is lodged. From this large Concavity a small Sinuosity is con-
Interior Surface.

tinued obliquely forwards, at the Inside of the anterior inferior spinal Process, where the conjoined *Psoas* and *iliacus* Muscles pass. The large Concavity is bounded below by a sharp Ridge, which runs from behind forwards; and being continued with such another Ridge of the *Os Pubis*, a Line of Partition is drawn between the *Abdomen* and *Pelvis*. All the internal Surface of the *Os Ilium*, behind this Ridge, is very unequal; for the upper Part is flat, but spongy, where the *sacro-lumbalis* and *longissimus dorsi* rise. Below this a transverse Ridge stands out, from which Ligaments go out to the *Os sacrum*; and immediately below this Ridge the rough unequal Cavities and Prominences are placed, which are exactly adapted to those described on the Side of the *Os sacrum*: And in the same manner the superior Part of this rough Surface is porous, for the firmer Adhesion of the ligamentous cellular Substance; while the inferior Part is more solid, and covered with a thin cartilaginous Skin, for the immoveable Articulation of the Bones. Round all this large unequal Surface Ligaments rise to be fixed to the *Os sacrum*, to secure more this Conjunction of these Bones.

The Passages of the medullary
Medullary Vessels are very conspicuous both
Vessels. in the *Dorsum* and *Costa* of many
Ossa Ilium; but in others they are inconsiderable.

These Bones are thick at their posterior and inferior Parts, but are generally exceeding thin and compact at their Middle, where they are exposed to the
 Actions

Actions of the *Musculi glutæi* and *Iliacus internus*, and to the Pressure of the Bowels contained in the Belly. The Substance of the *Ossa Ilium* is mostly cellular, except a thin external Table.

In a ripe Child the Spine of the *Os Ilium* is cartilaginous, and is afterwards joined to the Bone in Form of an *Epiphyse*, and the large inferior End of this Bone is not completely ossified. In a Child.

OS ISCHIIUM * is of a very irregular Figure, and is situated lowest of those that compose the *Os innominatum*. *Os Ischi-um.* Its Extent might be marked by a horizontal Line drawn through near the Middle of the *Acetabulum*; for the superior bulbous Part of this Bone forms some less than the inferior Half of that great Cavity, and the small Leg of it rises to much the same Height on the other Side of the great Hole common to this Bone and the *Os Pubis*. This Bone therefore is about a middle Bulk between the other two Bones.

From the superior thick Part of this *Os Ischium* a sharp Process stands out backwards, from which chiefly the *Musculus coccygeus Eustachii*, and strong Ligament that is fixed to the *Os sacrum* and *Coccygis* rise; which, with the other Ligaments that are stretched between these Bones and the *Ossa innominata*, serve as a sure Defence to the Sides of the *Pelvis*; and particularly the sciatic Nerve and posterior crural Vessels

* *Coxæ, coxendicis, pixis.*

are protected by them, while the contained Parts find in them a soft but strong Support.

Immediately below this sharp-
Depressions. pointed Process, which some thence call *spinofus*, a Sinuosity is formed for the Tendon of the *Musculus obturator internus* to play on. In a recent Subject this Pulley is covered with a ligamentous Cartilage, that by two or three small Ridges points out the Interstices of the Fibres in the Tendon of this Muscle. The exterior Surface of the Bone at the Root of this spinous Process is hollowed by the *Pyriformis* or *Iliacus externus* Muscle, and the Print of some Part of the *Obturator Externus* may be seen at the inferior Part of the Brim of the *Acetabulum*.

Below these Sinuosities the great *Tuber.* Tuberosity or Knob on which we sit is conspicuous. This, by the Pressure it suffers from the Weight it supports, has its Extremity flat and smooth, and in a recent Subject is covered with a Cartilage, or tendinous Substance rather, according to *Winslow* (a); but its Base is rough, to afford a convenient Origin to a great many Muscles: For the inferior *Gemellus* rises from the upper Part, the *Quadratus* from the anterior, the largest Head of the *Triceps* from the posterior, and the *seminervosus*, *semimembranosus*, and long Head of the *Biceps*, from the inferior Part of this Tuberosity; which, as it advances forwards, becomes smaller, but is still rough, for the Origin of the *Erector penis*. From this flat
 Pro-

(a) Exposition Anatomique du corps humain, traité des Os frais, § 96.

Process the *Os Ischiâ* turning much smaller, and mounting up with a considerable Curve, is stretched out into its small Leg, the Edge of which is rough and prominent, where the two inferior Heads of the *Triceps* take their Rise.

The Substance of the *Os Ischiâ* is much the same as of the former *Substance*. Bone. It has no immediate Connexion with any other, except with those which with it constitute the *Os innominatum* of the same Side.

In an Infant the great thick Part of this Bone is yet in a cartilaginous State; and the spinous Processes, great Tuberosity and recurved Leg, are all in the same Condition. The *Tuber* is afterwards added in the Manner that other *Epi-physes* are.

The *OS PUBIS* *, or Share-bone, is situated in the middle anterior and internal Part of the *Os innominatum*. The thick largest Part of this Bone is employed in forming the *Acetabulum*; from which becoming much smaller, it is stretched inwards to its Fellow of the other Side, where again it grows larger, and sends a small Branch down to join the Extremity of the small Leg of the *Os Ischiâ*.

On the superior Part of the *Os Pubis* a Ridge runs in a continued Line with such another of the *Os Iliû*, which divides the *Abdomen* and *Pelvis*. Near each End of this Ridge a small Protuberance appears on the *Os Pubis*, to which the

S 3

dupli-

* Pectinis, penis, pudibundum, fenestratum.

duplicated Tendon of the *Musculus descendens abdominis*, commonly called the *Ligamentum Pubis*, is connected at each Extremity, so as to leave a Passage behind its Middle for the anterior crural Vessels and Nerves, which make the Bone both hollow and smooth in this Place. At the anterior and internal Part of this Concavity a small Ridge rises, where the *Musculus rectus* and *pyramidalis* are inserted; and from the opposite End of the Hollow, another Ridge runs obliquely outwards and down, towards the *Acetabulum*, to give Rise to the *Pectineus*. Immediately below where this Ridge is to take the Turn down, a winding Niche, comprehended in the great *Foramen*, is formed in the *Os Pubis*, to allow a Passage for the posterior crural Nerve, an Artery and a Vein. The internal Extremity of the *Os Pubis* is rough and unequal, for the firmer Adhesion of the thick ligamentous Cartilage, that connects it to its Fellow of the other Side: And the Process which goes down from that to the *Os Ischiûm* is broad and rough before, where the *Gracilis* and upper Heads of the *Triceps*, or rather *Quadriceps adductor femoris*, have their Origin.

The Substance of the *Os Pubis* is much of kin to that of the two former Bones.

Only Part of the large Extremity of this Bone is ossified, and the whole Leg is cartilaginous in a Child born to the full Time.

Betwixt the *Os Ischiûm* and *Pubis* a very large irregular *Foramen* is left, which, from its Resemblance to a Door

Door or Shield, has by some been called *Thyroides*. This Hole is all, except the Niche for the posterior crural Nerve, filled up in a recent Subject with a strong ligamentous Membrane, that adheres very firmly to the Circumference of this Hole: From the Membrane chiefly the two *Obturatores*, external and internal, take their Rise. The great Design of this *Foramen*, besides rendring the Bone lighter, would appear to be, for allowing a strong enough Origin to the *obturator* Muscles, and sufficient Space for lodging their Bellies, that there may be no danger of disturbing the Functions of the contained *Viscera* of the *Pelvis* by the Actions of the internal, nor of the external being bruised by the Thigh-bone, especially by the lesser *Trochanter* in the Motions of the Thigh inwards: Both which Inconveniencies must have happened, had the *Ossa innominata* been complete here, and of sufficient Thickness and Strength to serve as the fixed Point of these Muscles.

In the external Surface of the *Ossa innominata*, very near the Out- *Acetabulum* side of the great *Foramen*, a large deep Cavity is formed by all the three Bones conjunctly: For the *Os Pubis* constitutes about one Fifth; the *Os Ilium*, something less than two Fifths, and the *Os Ischium*, as much more than two Fifths. The Brims of this Cavity are very high, and are, in a recent Subject, still vastly more enlarged by the ligamentous Cartilage, with which these Brims are tipped. From this Form of the Cavity it has been called *Acetabulum*; and for a distinguishing Character, the Name of the Bone that constitutes the

the largest Share of it is added; therefore *Acetabulum ossis ischii* * is the Name this Cavity commonly bears. Round the Base of the *Supercilia* the Bone is rough and unequal, where the circular Ligament of the Articulation is fixed. The Brims at the superior and back Circumference of the *Acetabulum* are much larger and higher than any where else; which is very necessary, to prevent the Head of the *Femur* from slipping out of its Cavity at this Place, where the whole Weight of the Body bears upon it, and consequently would otherwise be constantly in danger of thrusting it out. As these Brims are extended down and forwards, they become less; and at their internal inferior Part a Breach is made in them, at the Side of the great *Foramen*. From the one Side of which Breach to the other, a Ligament is placed in the recent Subject; under which again a large Hole is left, which contains a fatty cellular Substance and Vessels. The Reason of which Appearance has afforded Matter of Debate. To me it seems evidently contrived for allowing a larger Motion to the Thigh inwards: For if the bony Brims had been here continued, the Neck of the *Femur* must have struck upon them when the Thighs are crossed, which, in a large strong Motion this Way, would have endangered the Neck of the one Bone, or Brim of the other. Then the Vessels which are distributed to the Joint may safely enter at the Sinuosity in the Bottom of the Breach; which being however larger than is necessary for that Purpose, serves

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* *Coxa, coxendicis,*

another very good Use, remarked by *Petiv* (a), which is, to allow the large mucaginous Gland of the Joint to escape below the Ligament, when the Head of the Thigh-bone is in hazard of pressing too much upon it in the Motions of the Thigh outwards. Besides this Difference in the height of the Brims, the *Acetabulum* is otherwise unequal: For the inferior internal Part of it is depressed below the cartilaginous Surface of the superior Part, and has no smooth cartilaginous Surface; into its upper Part, where it is deepest, and of a semilunar Form, the Ligament of the Thigh-bone, which is commonly, tho' improperly, called the round one, is inserted; while in its more superficial inferior Part the large mucilaginous Gland of this Joint is lodged. The largest Share of this separate Depression is formed in the *Os Ischium*.

From what has been said of the Condition of the three Bones composing this *Acetabulum* in new born Children, it must be evident that a considerable Part of this Cavity is cartilaginous in such.

The *Ossa innominata* thus formed of three Bones on each Side intimately united in Adults, are at their posterior Part firmly conjoined to each Side of the *Os sacrum* by a sort of Suture, with a very thin intervening Cartilage, and at their anterior Part to each other by *Synchondrosis*, while their *Acetabula* afford a fixed Socket for the Thigh-bones to play in. Wherefore one would be-

(a) Memoires de l'Acad. des Sciences, 1722.

believe these Bones would not partake of any Motion, except what they have in common with the whole Trunk of the Body, or with the *Os sacrum*; and that such a prodigious Force as would be sufficient to make them se-

parate, would endanger the Person
Phænomena. to whom it was applied. However it has been a controverted

Question, strenuously debated among Anatomists, Whether the *Ossa Ilium* separate from the *sacrum*, or the *Ossa Pubis* from one another, in time of Child-birth? After the Experiments and Observations related by *Spigelius* (a), *Riolan* (b), *Diemerbroek* (c) and others, one cannot well deny that such a Thing may and does happen; but then we should, with *Morgagni* (d), beware of regarding this as a constant *Phænomenon*, which is only found in a few extraordinary Cases. This I can from my own Experience aver, that tho' I have frequently applied my Fingers to the Conjunction of the *Ossa Pubis* in very laborious Births, on purpose to satisfy myself in this Matter; yet I never could be sensible of such a separation or Removal of the Bones from each other. And as I said formerly it is most reasonable to think that very great Inconveniences would attend the Separation of the *Ossa Ilium* from the *Os sacrum*. I have seen some Women of a delicate tender Make, who after severe Child-bearing complained of Pain and Weakness, and as they thought of a jirking

(a) Lib. 2. cap. 34.

(b) Anthropograph. lib. 6. cap. 12.

(c) Anat. lib. 9. cap. 16.

(d) Adversar. 2. animad. 15.

ing Motion in this Place, which I could not be the least sensible of with my Fingers. For several Months they could neither sit nor stand without Pain, and had a Weakness here much longer.

We may now conceive what a large Cavity the *Pelvis* is, strongly fenced by Bones for the Safety and Support of the contained *Viscera*, and for the Origin and Insertion of a great Number of Muscles; while at the same time there is such a Distance left between its Bones at the inferior Part, as may allow sufficient Space for the large Excretories, the *Vesica urinaria*, *Intestinum rectum*, and in Women the *Uterus*, to discharge themselves.

The *THORAX* *, or Chest is the only Part of the Trunk of *THORAX*. the Body now undescribed. It reaches from below the Neck to the Belly; and by means of the Bones that guard it, is formed into a large Cavity: The Figure of which is somewhat conoidal; but its superior smaller Extremity is not finished, being left open for the Passage of the Wind-pipe, Gullet and large Blood-vessels; and its inferior Extremity or the Base is unguarded with Bones, and is shorter before than behind; so that, to carry on our Comparison, it appears like an oblique Section of the Conoid. Besides which we ought also to remark, with *Albinus* (a), that the lower Part of this Cavity is narrower than some Way above; and that the Middle of the posterior Part of the Cavity is considerably diminished by the Ribs

turn-

* Pectus, cassum.

(a) De Ossib. § 169.

turning forwards, and by the Bodies of the *Vertebrae* of the Back being prominent within the *Thorax*.

The Bones which form the *Thorax* are the twelve dorsal *Vertebrae* behind, the Ribs on the Sides, and the *Sternum* before.

The *Vertebrae* have already been described as Part of the Spine, and therefore are now to be passed.

The *RIBS*, or *Costæ* *, (as if they were *Custodes* or Guards to these principal Organs of the animal Machine, the Heart and Lungs) are the long crooked Bones placed at the Side of the Chest in an oblique Direction downwards in respect of the Back-bone. Their Number is generally twelve on each Side, tho' frequently eleven or thirteen have been found. I never saw fewer or more than the ordinary Number; but in the Skeleton of a Boy about eight Years old, now in my Possession, the fourth and fifth Ribs of the left Side are grown together at their Roots for near an Inch, and afterwards dividing, have the same Appearance as the Ribs of the opposite Side, which are naturally formed.

The Ribs are all convex externally, and concave internally, where they are also made smooth by the Action of the contained Parts, which on this Account are in no Danger of being hurt by them. The Extremities of the Ribs next the *Vertebrae* are rounder than after these Bones have advanced forwards, when they

* Πλευραί, περιέγνα, σπάθα.

they become flatter and broader, and have a superior and inferior Edge, each of which is made rough by the Action of the *intercostal* Muscles inserted into them. These Muscles, being all of near equal Force, and equally stretched in the Interstices of the Ribs, will resist these Bones having their broken Ends, in a Fracture, removed far out of their natural Place to interrupt the Motion of the vital Organs. The upper Edge of the Ribs is more obtuse and rounded than the inferior, which is depressed on its internal Side by a long *Fossa*, for lodging the intercostal Vessels and Nerves. This Channel is not observable however at either Extremity of the Ribs; for at the posterior or Root, the Vessels have not yet reached the Ribs, and at the anterior Extremity they are split away into Branches, to serve the Parts between the Ribs, which plainly teaches Surgeons, how much safer it is to perform the Operation of the *Empyema* towards the Sides of the *Thorax*, than either near the Back or Breast, tho' there were no other Reasons to determine them in the Choice of the Place where this Operation should be performed.

At the posterior Extremity * of each *Rib*, a little Head is formed, which is divided by a middle Ridge into two plain or hollow Surfaces, the inferior of which is the broadest and deepest. The two Plains are joined to the Bodies of two different *Vertebræ*, and the Ridge forces it self into the intervening Cartilage. A little Way from this Head, we find on the external Surface a small Cavity, where mucilaginous

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* *Κεφάλιον*, Remulus.

Laginous Glands are lodged ; and round the Head the Bone appears spongy, where the circular Ligament of the Articulation is fixed. Immediately beyond this a flattened Tubercle rises with a small Cavity at and Roughness round the Root of it, for the Articulation of the Rib with the transverse Process of the lowest of the two *Vertebrae*, with the Bodies of which the Head of the Rib is joined. Advancing still a little further on this external Surface, we observe another smaller Tubercle, into which the Tendons of the *Longissimus dorsi* are inserted. Soon after this the Ribs make a considerable Curve, which some call their Angle ; into it the *Sacro-lumbalis* is inserted. Then the Rib begins to turn broad, and continues so to its anterior Extremity †, which is hollowed and spongy, for the Reception of and firm Coalition with the Cartilage that runs thence to be inserted into the *Sternum*, or to be joined with some other Cartilages. In Adults, generally the Cavity at this anterior Extremity of the Ribs is smooth and polished on its Surface, by which the Articulation of the Cartilage with it would seem designed for Motion, which however is not allowed.

The Substance of the Ribs is spongy, cellular, and only covered with a very thin external lamellated Surface, which is thicker and stronger near the *Vertebrae* than at the anterior Extremity.

To each Rib a long broad and strong Cartilage is fixed, and reaches thence to the *Sternum*, or is adjoining

† Πλάτη, Palmula.

ing to the one next it. This Course however of theirs, is not in a streight Line with the Rib, for generally the Cartilages make a considerable Curve, the concave Part of which is upwards; therefore, at their Insertion into the *Sternum*, make an obtuse Angle above, and acute one below. These Cartilages are of such a Length, as never to allow the Ribs to come to a right Angle with the Spine, but keep them situated so obliquely as to make a very considerable obtuse Angle above, 'till once a Force Superior to the Elasticity of the Cartilages is applied. These Cartilages, as all others, are firmer and harder internally, than they are on their external Surface; and sometimes in old People, according to *Vesalius* (a), all their middle Substance becomes bony, while a thin cartilaginous *Lamella* appears externally, tho' the Ossification begins much oftner at the external Surface. The greatest alternate Motions of the Cartilages being made at their great Curvature, that Part, as *Havers* (b) has remarked, remains frequently cartilaginous after all the rest is ossified.

The Ribs then are articulated at each Extremity, of which the po- *Articulation,*
sterior is doubly joined to the *Ver-*
tebrae, for the Head is received into the Cavi-
ties of two Bodies of the *Vertebrae*, by what I
called the second Species of *Ginglymus*; and
the larger Tubercle is articulated to the trans-
verse Process of the inferior *Vertebra*, by what
is commonly called *Arthrodia*, which I com-
prehended

T 2

(a) Lib. 1. cap. 19.

(b) Osteolog. nov. Disc. 5.

prehended under the *Enarthrosis*; and if we were to consider conjunctly both these Articulations of any Rib with the *Vertebrae*, it would come under the third Species of *Ginglymus*. As soon as one considers this double Articulation, he must immediately see, that no other Motion can here be allowed than up and down, since the transverse Processes hinder it to be thrust back; the Resistance on the other Side of the *Sternum*, prevents the Rib's coming forward; and each of the two Joints with the other Parts attached, oppose their turning round: But then 'tis likewise as evident, that even the Motion upwards and downwards, can be but small in any one Rib at the Articulation it self, tho' it may be very conspicuous at the anterior Extremity, which moves in a Circle, whose *Radius* is the Length of the Rib. If at the same time, we consider how obliquely the Ribs are situated in respect of the *Vertebrae*, we must be convinced, that the Ribs cannot be raised without removing farther from the Back-bone; and as a considerable Resistance is made by the *Sternum* to their anterior Extremities, these Bones must, in moving upwards, be also turned outwards, as *Winslow* (a) has proved. The anterior End of the Ribs has no proper movable Articulation, except so far as the Cartilages between the *Sternum* and Ribs will yield, on which Account and because of the Resistance, such Ribs as perform large Motions under these Disadvantages, are commonly twisted towards their anterior Extremities.

Hither-

(a) *Memoires de l'Acad. des Sciences* 1720.

Hitherto I have laid down the Structure and Connexion which *Distinguished* most of the Ribs enjoy, as belonging to all of them; but must now consider the Specialities wherein any of them, either collectively or singly, may differ from the general Description given, or from each other.

In viewing the Ribs from above downwards, their Figure is still straighter, the uppermost being the most crooked of any. Their Obliquity in respect of the Spine increases as they descend; so that tho' the Distance of their posterior Extremities from each other are very little different, yet at their anterior Extremities the Distances between the inferior ones must increase. In consequence too of this increased Obliquity of the inferior Ribs, each of the Cartilages of the inferior Ribs makes a greater Curve in its Progress from the Rib towards the *Sternum*, and the Tubercles, that are articulated to the transverse Processes of the *Vertebrae*, have their smooth Surface gradually facing more upwards. The Ribs becoming thus more oblique, while the *Sternum* advances forward in its Descent, make the Distance between the *Sternum* and the anterior Extremity of the lower Ribs greater than between the *Sternum* and the superior Ribs, consequently the Cartilages of those Ribs that are joined to the Breast-bone are longer in the lower ones. These Cartilages are placed nearer to each other as the Ribs descend, which assists to oblige the Curvature of the Cartilages to be greater.

The Length of the Ribs increases from the first or uppermost Rib, as far down as the

seventh, and from that to the twelfth as gradually diminishes. The superior of the two plain, or rather hollow Surfaces, by which the Ribs are articulated to the Bodies of the *Vertebrae*, gradually increases from the first to the fourth Rib, and is diminished after that in each lower Rib; and the Distance of their Angles from the Heads always increases as they descend to the ninth. This is remarked by *Winslow* (a).

Livid. d. The Ribs are commonly divided into True and False.

The *True * Costæ* are the seven *True Ribs*. superior of each Side, whose Cartilages are all gradually longer as the Ribs descend, and are joined to the Breast-bone; so that being pressed constantly between two Bones, they are flattened at both Extremities, and are thicker, harder, and more liable to ossify than the other Cartilages, that are not subject to so much Pressure. These Ribs include the Heart and Lungs, and therefore are the proper or true *Custodes* of Life.

The Five inferior of each Side *False Ribs*. are the *False*, or *BASTARD **, whose Cartilages do not reach the *Sternum*; and therefore, wanting that Resistance at their anterior Extremity, are there pointed; and for the same Reason being less pressed, the Substance of these Cartilages is softer. The Cartilages of these *false Ribs* are shorter

(a) Exposition Anatomique des Os secs § 643.

* Γνήσιαι, Germanæ, legitimæ.

* Μαλθακαί, χονδροειδείς, ἀκαταί, κλίνας, ἐλαί, Adulterinæ, spuria, illegitimæ.

shorter as the Ribs descend. To all these five Ribs the circular Edge of the *Diaphragm* is connected; and its Fibres, instead of being stretched immediately transversely, and so running perpendicular to the Ribs, are pressed so as to be often, especially in Expiration, parallel to the Plane in which the Ribs ly; nay, one may judge by the Attachments which these Fibres have so frequently to the Sides of the *Thorax*, a considerable Way above where their Extremities are inserted into the Ribs, and by the Situation of the *Viscera*, always to be observed in a dead Subject laid supine, that there is constantly a large Concavity formed on each Side by the *Diaphragm* within these bastard Ribs, in which the Stomach, Liver, Spleen, &c. are contained, which being only reckoned among the *Viscera naturalia*, have occasioned the Name of *Bastard Custodes* to these Bones.

Hence we may easily understand the Justice of *Hippocrates's* (a) Rule in simple Fractures of the false Ribs, without a Fever, to keep the Stomach moderately filled with Food, lest the pendulous Ribs falling inwards, should thereby increase the Pain, Cough, &c. The Truth of this Observation *Paré* (b) after his long Experience confirms; but it is now-a-days much forgot, or entirely neglected.

The uppermost or first Rib has several proper Specialities; some of them contradictory to any Character yet delivered of the Ribs; for the Figure of it is much more
curve

(a) De Articulo.

(b) Lib. 15. cap. 11.

curve than any of the rest whence the Name of ἀρτίσποναι, *Retortæ*, has been applied to it and the second. The Situation of the first is such, that the flat Sides are superior and inferior, while the Edges are anterior and posterior, or near so; therefore sufficient Space is left above it for the Subclavian Vessels and Muscle; and the broad concave Surface of it is opposed to the Lungs: But then in consequence of this Situation, the Channel for the intercostal Vessels is not to be found, and the Edges are differently formed from all the other except the second, the lower one being rounded and the other sharp. The Head of this Rib is not divided into two plain Surfaces by a middle Ridge, because it is only articulated with the first *Vertebra* of the *Thorax*. The Cartilage at the anterior Extremity of the first *Costa*, is ossified in Adults, and is united to the *Sternum* at right Angles. Frequently this first Rib has a Ridge rising near the Middle of its posterior Edge, where one of the Heads of the *Scalenus* Muscle rises; and nearer to the anterior Extremity, it is flattened, or sometimes depressed by the Clavicle.

3. 4. The third and fourth Ribs have been distinguished by the Name of στήθεα, *Solida*; the fifth and sixth, by the Appellation of σπυρίτιδες, *Pectorales*; the seventh and eight are called ἀεγούρα, *Distractæ*. But it must be acknowledged, there is no great Occasion or good Reason for these Names, since these Ribs scarce can claim any Thing particular, but what comes under the general Description, or belongs to more than two of them. The fifth, sixth, seventh,

or

or rather the sixth, seventh, eighth, and sometimes fifth, sixth, seventh, eighth, ninth Ribs have their Cartilages at least contiguous; and frequently they are conjoined by cross Cartilages; and most commonly the Cartilages of the eighth, ninth, tenth are connected to the former, and to each other, by firm Ligaments.

The eleventh and sometimes the tenth Rib, has no Tubercle for its Articulation 11. with the transverse Process of the *Vertebra*, to which it is only loosely fixed by a Ligament. The *Fossa* in its inferior Edge, is not so deep as in the superior Ribs, because the Vessels run more towards the Interstice between the Ribs. Its anterior Extremity is smaller than its Body, and its short small Cartilage is but loosely connected to the Cartilage of the Rib above.

The twelfth Rib is the shortest and straightest: The Head of it is only articulated 12. with the last *Vertebra* of the *Thorax*, therefore is not divided into two Surfaces. This Rib is not joined to the transverse Process of the *Vertebra*, and therefore has no Tubercle, being often pulled necessarily inwards by the Diaphragm, which an Articulation with the transverse Process would not have allowed. The *Fossa* is not found at its under Edge, because the Vessels run below it. The anterior Extremity of this last Rib is smaller than its Middle, and has only a very small pointed Cartilage fixed to it. To the whole Length of this Rib internally the Diaphragm is connected.

The Motion and Uses of the Ribs shall be more

more particularly treated of, after the Description of the following Bone.

The Ribs are all complete in a new born Child, only their Cartilages are proportionally longer than in an adult Person.

Here I cannot help remarking the wise Providence of our Creator, in preserving us from perishing as soon as we come into the World. The Extremities by which the Bones of the Limbs are articulated remain in a cartilaginous State after Birth, and are many Years before they are intirely united to the main Body of their several Bones; whereas the Condyles of the occipital Bone, and of the lower Jaw, and the Heads and Tubercles of the Ribs, are true original Processes and ossified before Birth, and therefore the Weight of the large Head is firmly supported, the Actions of Sucking, swallowing, Respiration, &c. which are indispensably necessary for us as soon as we come into the World, are performed without any Danger of the Parts of the Bones that are most pressed on in these Motions being separated; whereas, had these Processes of the Head, Jaw, and Ribs been Epiphyfes at Birth, Children must have been exposed to an evident Danger of dying by such a Separation, whose immediate Consequences would be the Compression of the Beginning of the *Medulla spinalis*, or want of Food or of Respiration.

The *STERNUM**, or Breast-bone, is the broad flat Bone, or Pile of Bones at the anterior Part of the

* स्तनदण्ड, Os Pectoris, ensiforme, scutum cordis.

the *Thorax*. The Number of Bones this should be divided into, has occasioned Debates among Anatomists, who have considered it in young Subjects of different Ages. In Adults of a middle Age, it is composed of three Bones, which easily separate after the Cartilages connecting them are destroyed: Frequently the two lower Bones are found intimately united, and very often in old People, the *Sternum* is a continued bony Substance from one End to the other, tho', on the Surface of it, we may still observe two, sometimes three transverse Lines, which mark out the former Divisions.

When we consider the *Sternum* as one Bone, we find it broadest and thickest above, and becoming smaller as it descends. The internal or posterior Surface of this Bone is somewhat hollowed for enlarging the *Thorax*, but the Convexity on the external Surface, is not so conspicuous, because the Sides are pressed outwards by the true Ribs, the round Heads of whose Cartilages are received into seven smooth Pits formed in each Side of the *Sternum*, and are kept firm there by strong Ligaments, which on the external Surface have a particular radiated Texture (a): Frequently the cartilaginous Fibres thrust themselves into the bony Substance of the *Sternum*, and are joined by a Sort of Suture. The Pits at the superior Part of the *Sternum*, are at the greatest Distance one from another, and as they descend are nearer, so that the two lowest are contiguous.

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(a) Ruyfch Catalog. Rar. Fig. 9.

The Substance of the Breast-bone is cellular, with a very thin external Plate, especially on its internal Surface, where, with *Jac. Sylvius (a)* we may frequently observe rather a cartilaginous Crust spread over it. On both Surfaces however, a strong ligamentous Membrane is closely braced, and the Cells of this Bone are so small, that a considerable Quantity of osseous Fibres must be employed in the Composition of it: Whence, with the Defence the Muscles give it, and the movable Support it has from the flexible Cartilages, it is sufficiently secured from being broke by any small external Force: For it is strong by its Quantity of Bone; its Parts are kept together by the Ligaments, and it yields enough to elude considerably the Violence offered.

So far in general may be said of this Bone; but to descend to its particular Description, let us examine the three Bones, which, according to the common Accounts, go to the Composition of it in an Adult.

The first, all agree, is somewhat of the Figure of a Heart, as it is commonly painted, only it does not terminate in a sharp Point. This is the uppermost thickest Part of the *Sternum*.

The superior Middle Part of this first Bone, where it is thickest, is hollowed, to make Place for the *Trachea arteria*, tho' this Cavity* is principally formed by the Clavicles pressing on one Side, and by the *Sternomastoidei* Muscles

(a) In Galen de ossibus, cap. 12.

* Σφαγν̃, Jugulum, Furcula superior.

cles pulling the Substance of the Bone above, to both which it yields while it is soft, and therefore is raised here into two Tubercles, while the middle is not protruded by such Powers. On the Outside of each Tubercle, there is an oblong Cavity, that, in viewing it transversely from before backwards, appears a little convex: Into these *Glenæ* the Extremities of the Clavicles are received. Immediately below these, the Sides of this Bone begin to turn thinner, and in each a superficial Cavity or a rough Surface is to be seen, where the first Ribs are received or conjoined to the *Sternum*. In the Side of the under Extremity of this first Bone the Half of the Pit for the second Rib on each Side is formed. The superior Part of the posterior Surface is covered with a strong Ligament described by *Weitbreicht* (a) and *Winflow* (b), which secures the Clavicles, and is afterwards to be more particularly taken notice of.

The second or middle Division of this Bone, is much longer, narrower, and thinner than the first, but, excepting that it is a little narrow above, is pretty equal all over as to its Dimensions of Breadth or Thickness. In the Sides of it are complete Pits for the third, fourth, fifth and sixth Ribs, and half of the Pits for the second and seventh are formed in it. Near its Middle an unossified Part of the Bone is sometimes found, which freed of the ligamentous Membrane or Cartilage that fills it, is described as a

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Hole;

(a) A&A. Petropolit. Tom. iv. p. 255.

(b) Des Os frais, § 248.

Hole; and in this Place, for the most Part, we may observe a transverse Line running, that has made Authors divide this Bone into two. When the Cartilage between this and the first Bone is not ossified, a manifest enough Motion of this upon the first may be observed in Respiration, or in raising the *Sternum* by pulling the Ribs upwards in a recent Subject.

The third Bone is by much *Cartilago xiphoides*. the least, and has only one Half of the Pit for the seventh Rib formed in it; wherefore it might be reckoned only an *Appendix* of the *Sternum*. In young Subjects it is always cartilaginous, and is better known by the Name of *Cartilago xiphoides* or *ensiformis* *, than any other, tho' the Ancients often called the whole *Sternum*, *Ensiforme*, comparing the two first Bones to the Handle, and this *Appendix* to the Blade of a Sword. This Bone is seldom of the same Figure, Magnitude or Situation in any two Subjects; for sometimes it is a plain triangular Bone, with one of the Angles below, and perpendicular to the Middle of the superior Side, by which it is connected to the second Bone. Other Times the Point is turned to one Side or other, or obliquely forwards or backwards. Frequently it is all of near an equal Breadth, and in several Subjects, the Extremity of it is bifurcated; whence some Writers give it the Name of *Furcella* or *Furcula inferior*; or else it is perforated in the Middle. In the greatest Number of Adults it is ossified; and

* *Clypealis, gladialis, mucronata, malum granatum, scutum stomachi, epiglottalis, cultralis, Medium Furculæ inferioris, scutiformis, ensiculata.*

and tipped with a Cartilage; in some it is Half or whole Cartilage.

So many different Ways this small Bone may be constituted, without any *Diseases*, Inconvenience: But then some of these Positions may be so directed, as to bring on a great Train of ill Consequences; particularly, when the lower Extremity is entirely ossified, and is too much turned outwards or inwards, or when the Conjunction of this *Appendix* with the second Bone is too weak. *Rolfincius* (a) relates the History of an old Man, who could not bend his Body forwards, without a violent pungent Pain from the Ossification and sharp Point of this Bone. *Paaw* (b) assures us, he has seen several Instances of a difficult Breathing from the same Cause, and enumerates several Diseases, such as a *Pthisis pulmonalis*, *Obstructions of the Spleen, Liver, or Mesentery*, which may depend on too great a Relaxation of this Cartilage; and sometimes this Relaxation may only be a Consequence of these Diseases. *Borrichius* (c) confirms all this by some Examples. But not to be tedious in relating such Histories, I shall refer you to *Bonetus* (d), who has several Examples collected, and will direct you to the Writers on this Subject, which in the last Century employed several Pens, tho' it is now much neglected. This Neglect is the more surprising, since the Connexion of the Diaphragm here,

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(a) Differt. Anat. lib. 2. cap. 47.

(b) De Ossibus, part 1. cap. 3. & part. 3. cap. 3.

(c) Aët. Hafn. Vol. 5. Obs. 79.

(d) Sepulchret. Anat. tom. 2. lib. 3. Sect. 5. Appendix ad observ. 8. & ibid. Sect. 7, Obs. 19.

the Situation of the large Lobe of the Liver and of the Stomach, and the constant Pressure and rubbing of our Cloaths on this Part, leads us naturally to consider the Effects of a faulty Structure and Situation of this Bone.

The *Sternum* is joined by *Synchondrosis* to the seven superior Ribs, unless when the first coalesces with it in an intimate Union of Substance; and it is articulated with the *Clavicles* by a *Ginglymus* of the second Kind.

The *Sternum* most frequently has *of Children* four round small Bones, surrounded with Cartilage, in Children born to the full Time; the uppermost of these, which is the first Bone, being the largest by much. Two or three other very small bony Points are likewise to be seen in several Children. The Number of Bones increases for some Years, and then diminishes, but uncertainly, till they are at last united into those above described of an Adult.

The Uses of this Bone are, to afford *us* Origin and Insertion to several Muscles; to sustain the *Mediastinum*; to defend the vital Organs, the Heart and Lungs at the anterior Part; and lastly, by serving as a moveable *Fulcrum* of the Ribs, to assist considerably in Respiration: Which Action, so far as it depends on the Motion of the Bones, we are now at Liberty to explain.

When then the Ribs that are connected by their Cartilages to the *Sternum*, or to the Cartilages of the true Ribs, are acted upon by the intercostal Muscles, they must all be pulled from the oblique Position their Cartilages kept them

them in, nearer to right Angles with the *Vertebrae* and *Sternum*, because the first or uppermost Rib is by much the most fixed of any; and their large arched middle Part, as was remarked in the Description of the Ribs, will be turned outwards, to increase the Distance between the Sides of the *Thorax*, or to widen this Cavity; while by raising the Ribs nearer to right Angles, the Distance between the parallel Lines that comprehend their Extremities is increased: And as the *Vertebrae* hinder the Ribs to recede back, this whole Increase must be by the Advance of these Extremities forwards. Hence the intermediate *Fulcrum*, the *Sternum*, pressed strongly on both Sides, must be pushed forwards, and that, at its several Parts, in proportion to the Length and Motion of its Supporters the Ribs; that is, most at its inferior Extremity; which, thus forced forwards, will, with the Cartilages now in the same Manner acted upon, draw the *Diaphragm* connected to them; consequently so far stretch it, and bring it nearer to a Plain: And the same Power that raises this Bone and Cartilages, will sufficiently fix them, so as they may resist the Action of that Muscle, whose Fibres contract at the same time, and thrust the *Viscera* of the *Abdomen* downwards. The arched Part of the Ribs being thus moved outwards, the anterior Extremity of the Ribs and the *Sternum* being advanced forwards, and the *Diaphragm* being brought nearer to a plain Surface, instead of being greatly convex on each Side within each Cavity of the *Thorax*, 'tis evident how considerably the Cavity, of which the nine or ten superior of these Bones are the Sides, must be

widened, and made deeper and longer. But while this is doing in the superior Ribs, the inferior, whose Cartilages are not conjoined, perform a very different Office, tho' it conspires to the same Intention, the Enlargement of the *Thorax*: For as they have no fixed Point to which their anterior Extremity is fastned, and have the *Diaphragm* inserted into them at the Place where that Muscle runs pretty straight upwards from its Origin at the *Vertebrae*; therefore these Ribs being exposed on the one Side to the direct Action of this strong Muscle, and of the Muscles of the *Abdomen*, which at this time are resisting the stretching Force of the Bowels, and are drawing these Bones down, while the intercostal Muscles are pulling them upwards, the Effect of either of these Powers, which are Antagonists to each other, is very little as to moving the Ribs either up or down. But the Muscles of the *Abdomen* being pushed at this Time outwards by the *Viscera*, carry these Ribs along with them; and thus the *Thorax* is not only not allowed to be shortened, but is really widened at its lower Part, to assist in making sufficient Space for the due Distension of the Lungs.

As soon as the Action of these several Muscles ceases, the elastic Cartilages, extending themselves to their natural Situation, depress the superior Ribs, and the *Sternum* subsides; the *Diaphragm* is thrust up by the *Viscera abdominalia*, and raises the inferior Ribs with it, in which it is assisted by any Action their intercostal Muscles have; while the oblique and transverse Muscles of the Belly serve to draw

draw these Ribs inwards at the same time: From all which the Cavity of the Breast is diminished in all its Dimensions. Thus then the *Thorax* is made wider, deeper and longer, and is again straitned and shortned in a Manner not generally so well understood.

The last Part of the Skeleton, *viz.* the *Extremities* *, are only left undescribed. These are commonly divided into *superior* and *inferior*.

Of the superior Extremities.

AUTHORS here are much divided, how many Bones should be comprehended under this Designation; and have, according to their different Sentiments, ranged the same Bones under different Titles. To me it seems most natural, that all these Parts which are immediately concerned in and subservient to the Motions here performed, without being necessary to the *Thorax*, from which these superior Extremities depend; all such, I say, may and should be reckoned to belong to these useful Organs: And therefore I shall divide each superior Extremity into the *Shoulder*, *Arm*, *Fore-arm* and *Hand*.

The *SHOULDER* consists of the *Clavicle* and *Scapula*.

CLAVICULA, or Collar-bone †, is the long small crooked Bone,

* Κῶλα, γῦα, ἐκρούαδες, Enata, adnata, explantata membra, artus.

† Os jugulare, jugulum, furcula, ligula, clavis, humerus quibusdam,

Bone, in Figure like an *Italic f*, placed almost horizontally between the upper lateral Part of the *Sternum*, and what is commonly called the Top of the Shoulder. which as a *Clavis* or Beam it bears off from the Trunk of the Body.

The *Clavicle*, as well as other *Internal Extremity*, long round Bones, is larger at its two Extremities than in the Middle.

The internal Extremity *, I mean that next to the *Sternum*, is triangular: The Sides constituting the posterior Angle are considerably produced, so as to form a sharp Ridge, and the Side opposite to that is somewhat rounded. The Middle of this protuberant Extremity is as irregularly hollowed as the Cavity in the *Sternum* for receiving it is raised; but in a recent Subject, the irregular Concavities of both are supplied by a movable Cartilage, which is much more closely connected by Ligaments to the Circumference of the Articulation, than those of the lower Jaw.

From this internal Extremity, the *Body*. *Clavicle*, for about two Fifths of its

Length, is bended obliquely forwards and downwards. On the superior and anterior Part of this Curvature a small Ridge is seen with a plain rough Surface before it; whence the *Musculus sterno-hyoidens* and *sterno-mastoideus* have in part their Origin. Near the inferior Angle a small plain Surface is often to be remarked, where the first Rib and this Bone, according to *Dionis's* (a) Observation,

* Παρασφύς.

(a) Sixieme demonstr. des Os.

tion, are contiguous. From this a rough plain Surface is extended along this anterior Convexity, where the pectoral Muscle has Part of its Origin; and behind, the Bone is made flat and rough, by the Insertion of the larger Share of the subclavian Muscle. After the Clavicle begins to form the posterior Convexity, it is pretty round, but soon after becomes broad and flat; which Shape it retains to the external Extremity. Along the external Concavity a rough Sinuosity runs, from which some Part of the deltoid Muscle takes its Rise: And opposite to this, on the convex Edge, a scabrous Ridge gives Insertion to a Share of the *cucullaris* Muscle. The superior Surface of the Clavicle here is flat; but the inferior is hollow, for lodging the Beginning of the *Musculus subclavius*.

The external Extremity * of this Bone is horizontally oblong, External Extremity. smooth, sloping at the posterior Side, and tipped in a recent Subject with a Cartilage for its Articulation with the *Acromion scapulae*. Round this the Bone is spongy for the firmer Connexion of the Ligaments; and near the Fore-part of this Extremity a little rough Tubercle appears, from which a strong Ligament goes to the coracoid Process of the *Scapula*.

The medullary Arteries enter the Clavicles by one or more small Passages in the posterior middle Surface, Medullary Vessels. and are all slanting outwards.

The

* *Επαις*.

Substance. The Substance of this Bone is the same as of the other round long Bones.

Articulation. It is joined to the *Sternum* by what I called the second Species of *Ginglymus*, there being Protuberances and Depressions of the two Bones that form this movable Joint. The Ligaments, which surround this Articulation to secure it, are so short and strong, that little Motion can be allowed any one Way; and a strong Ligament that is stretched across the upper *Furcula* of the *Sternum* from the posterior prominent Angle of one Clavicle to the same Place of the other Clavicle, serves to keep each of these Bones more firmly in their Place. By the Assistance however of the movable intervening Cartilage, the Clavicle can at this Joint be raised or depressed, and moved backwards and forwards as much, as that the exterior Extremity, considering its Distance from that Axis, shall enjoy very conspicuous Motions. The Articulation of the other Extremity of the Clavicle shall be considered after the Description of the following Bone.

The Clavicles of Infants are not *of Infants.* deficient in any of their Parts, nor have they any Epiphyses at their Extremities joined afterwards to their Bodies, as most other such long Bones have, by which they are not bended too much, nor is there Danger of any unossified Parts being separated by the Force which pulls the Arms forwards.

The Uses of the Clavicles are, to keep *uses.* the *Scapulae*, and consequently all the superior

Superior Extremities, from falling in and forward upon the *Thorax*; by which, as in most Quadrupeds, the Motions of the Arms would be much confined, and the Breast made narrower. The Clavicles likewise afford a fixed Origin to several Muscles, and a Defence to some of the largest Vessels of the Body.

SCAPULA, or Shoulder-blade *, is the triangular Bone situated on the *Scapula*. Outside of the Ribs, and extended commonly from the second to the seventh true Rib; its superior posterior Angle, when it is in the least straining Position, being about three Inches from the spinal Processes of the *Vertebrae*, while the long Side between that Angle and the inferior one is stretched obliquely forwards as it descends, having nothing between it and the Ribs, except the thin Extremities of some Muscles; but as the *Scapula* advances forwards to its Articulation with the Arm-bone, its Distance from the Ribs increases.

The Sides and Angles of the *Scapula* are all unequal; for the posterior Side or Base is the longest, the inferior *Costa* is the second in Length, and the superior *Costa* is about as much proportionally shorter than the inferior, as this is than the Base. The inferior Angle is very acute, the superior is near to a right Angle; and what is called the anterior does not deserve the Name, for the two Sides do not meet to form an Angle. The Body of this Bone is concave towards the Ribs, and con-

* ὤμοπλάτης, ἐπιώτιον, Latitudo humeri, scoptulum vel scutulum opertum, spatula, ala, humerus, clypeus, scutum thoracis,

convex behind, where it has the Name of *Dorsum* *. Three Processes are generally reckoned to proceed from the *Scapula*. The first is the large Spine that rises from the posterior convex Surface, and divides it unequally. The second Process stands out from the anterior Extremity of the superior *Costa*; and from its imaginary Resemblance to a Crow's Beak is named *Coracoides* †. The third Process is the whole anterior thick bulbous Part of the Bone.

After thus naming the several constituent Parts of the *Scapula*, the particular Description will be more easily understood.

The Base, which is tipped with *Cartilage* in a young Subject, is not all straight: For above the Spine, this Side runs obliquely forwards to the superior Angle; in which oblique Space the *Musculus patientie* is inserted. At the Root of the Spine, on the Back-part of the Base, a triangular plain distinct Surface is formed by the lower Fibres of the *Trapezius*. Below this the posterior Edge of the *Scapula* is scabrous and rough for the Insertion of the *Serratus major anticus* and rhomboid Muscles. The inferior Angle is

made smooth on its posterior Surface, by the *latissimus dorsi* passing over it. From this forwards the inferior *Costa*, by the Action of that same Muscle, is for some Way brought to a more direct Course; and so far the posterior Surface is flattened by the Origin of the *Teres major*. As this

* Χελύσιον.

† Anchoroides, sigmoides, digitalis, ancistroides,

this inferior *Costa* runs forwards from this, it is of a considerable Thickness; and on its posterior Surface is slightly hollowed, and made smooth by the *Teres minor*; while it has a *Fossa* formed into it below by the *Teres major*; and between the two a Ridge with a small Depression appears, where the *longus extensor Cubiti* has its Origin. The superior *Costa* is very thin, and near its anterior Extremity has a semilunar Cavity formed in it; cross the Extremities of which a strong Ligament is stretched, and sometimes the Bone is continued, to form a Hole for the Passage of Blood-Vessels and Nerves. Immediately behind this Cavity the *Musculus coraco-hyoideus* has its Rise; and from it to the Termination of the *Fossa* for the *Teres minor*, the *Scapula* is narrower than any where else and supports the third Process. This Part has got the Name of *Cervix*.

The whole *Dorsum* is always said to be convex; but by reason of the raised Edges that surround it, it is divided into two Cavities by the Spine, which is stretched from behind forwards, much nearer to the superior *Costa* than to the inferior. The *Cavitas supraspinata* is really concave where the Muscle of the same Name is lodged; while the Surface of this Bone below the Spine is convex, except a *Fossa* that runs at the Side of the inferior *Costa*; and on this Surface the *Musculus infraspinatus* is placed. The internal or anterior Surface of this Bone is hollow, except in the Part above the Spine which is convex. In the Hollow the *subscapularis* Muscle is contained.

tained. When this Muscle is removed, several Ridges and intermediate Depressions appear, that at first View would seem to be adapted to the Ribs; but the *Scapula* is situated too obliquely for allowing the Ribs to make these Impressions in such a Direction; and they point out the Interstices of the Bundles of Fibres of which the *subscapularis* Muscle is composed, as *Winslow* (a) justly observes.

The Spine * rises small at the Base of the *Scapula*, and becomes higher and broader as it advances forwards. On the Sides it is unequally hollowed and crooked by the Actions of the adjacent Muscles. Its Ridge † is divided into two rough flat Surfaces: Into the superior the *Trapezius* Muscle is inserted; and from the inferior, Part of the *Deltoid* has its Origin. The Extremity of the Spine becomes very broad and flat, and is well known by the Name of the *Acromion*. *Acromion* * or Top of the Shoulder.

This in Children is an *Epiphyse*; and in some old Subjects I have seen it only joined by a Cartilage to the Spine. The interior Edge of the *Acromion* is flat, smooth, and covered with a Cartilage, for its Articulation with the external Extremity of the Clavicle; and its inferior Surface is hollowed, to allow a Passage for the *infra- and supra-spinati* Mus-

(a) Memoires de l'Acad. des Sciences 1722.

* Πάχης, ὑπερέχον ἀμοπλατῶν, Eminentia scapularum.

† Πρυγιῶν, cristæ.

* Ἡ ὀμὸς, ἀγκυροειδὴς, χοιρακοειδὴς, κατακλῆς, Acromii os, summus armus, rostrum porcinum, processus dig talis.

Muscles, and free Motion to the *Os humeri*.

The coracoid † Process is not straight, but a little crooked, with its Point inclining forwards; so that a Hollow is left at its inferior Root, for the Passage of the *infra-scapularis* Muscle. The Extremity of this Process is marked with three plain Surfaces: Into the internal, the *Serratus minor anticus* is inserted: From the external, one Head of the *Biceps flexor cubiti* rises; and from the inferior, the *Coracobrachialis* has its Origin. At the superior Root of this Process, immediately before the *Cavitas semilunaris*, a plain or rather somewhat hollowed Surface is made by the Origin of the other Head of the *Biceps flexor cubiti*; and from a rough scabrous Surface on the upper Part of the coracoid *Apophyse*, strong Ligaments go out, to connect it to the Clavicle and *Acromion*.

From the *Cervix scapulae* the third Process is produced. This is superficially hollowed on the anterior Part by a glenoid Cavity *, which is somewhat elliptical; but has an obtuse Extremity below, and an acute one above; therefore resembles much the Shape of the longitudinal Section of an Egg. Between the posterior Brims of this *Glene* and the anterior Root of the Spine a large Sinuosity is left, for the Transmision of the *supra-* and *infra-spinati* Muscles. The Root of the *Supercilia* is surrounded by a rough Circle, for the firmer

Third Process.

X 2

Ad-

† Ἀγκυροειδής, σιγμοειδής, Rostriformis.]

* Ὠμοκότυλις.

Adhesion of the circular Ligament of the Articulation, and of the Cartilage which is placed on these Brims, where it is very thick, but becomes very thin as it is continued towards the Middle of the Cavity, which it lines all over. The medullary Vessels enter the *Scapula* near the Base of the Spine.

Medullary Vessels.

The Substance of the *Scapula* is, as in all other broad flat Bones, cellular, but of a very unequal Thickness; for the Neck and third Process are very big and strong; the inferior *Costa*, Spine and coracoid Process, are of a middle Thickness; and the Body is so pressed by the Muscles, as to become diaphanous.

The *Scapula* and Clavicle are joined by plain Surfaces, tipped with Cartilage *, to which Sort of Articulation I applied the technical Name *Arthrodia*, by which neither Bone is allowed any considerable Motion, being tightly tied down by the common circular Ligament, and the proper one that proceeds from the coracoid Process; otherwise their Surface of Contact is so narrow, that they would be frequently dislocated: A small Flexion however is necessary, and therefore they are not united, into one Bone. Sometimes a movable ligamentous Cartilage is found in this Joint, otherwhiles such a Cartilage is only interposed at the anterior Half of it, and in some old Subjects I have found a sesamoid Bone here. The *Scapula* is connected by *Sysarcosis* to the Head,

Os

* Acromion, καταλήξ, clausura,

Os hyoides, *Vertebrae*, Ribs and Arm-bone; and by Means of the Muscles, that have one Extremity fastned to these Bones, and the other to the *Scapula*, it is moved upwards, downwards, backwards or forwards, and can turn in its own Plain, carrying always the exterior Extremity of the Clavicle and the Arm along with it, which Motions are at great Length explained by *Winslow* (a). The glenoid Cavity of this Bone receives the *Os humeri* by *Enarthrosis*; of which more hereafter.

The Use of the *Scapula* is to serve as a *Fulcrum* to the Arm; and, by altering its Position on different Occasions, to allow always the Head of the *Os humeri* a right situated Socket to move in, and thereby to assist and enlarge the Motions of the superior Extremitie, and to afford the Muscles which rise from it more advantageous Actions, by altering their Directions to the Bone they are to move. This Bone also serves to defend the Back-part of the *Thorax*, and is often employed to sustain Weights or resist Forces too great for the Arm to bear.

The Base, *Acromion*, coracoid Process and Head of the *Scapula*, are all in a cartilaginous State at the Birth; and the three first are joined as *Epiphyses*; while the Head, with the glenoid Cavity, is not formed into a distinct separate Bone, but is gradually produced by the Ossification of the Body of this Bone being continued forwards.

The *ARM* has only one *OS HUMERI*. Bone, best known by the Latin Name of *OS HUMERI**; which is long, round, and pretty straight, only a little convex on the Middle of the Fore-part; and depends from the *Scapula*.

The superior Extremity of this Bone* is formed into a large round smooth Head, whose middle Point is not in a straight Line with the Axis of the Bone, but stands obliquely backwards from it. The Extent of the Head is distinguished by a circular *Fossa* surrounding its Base, where this Head is united to the Bone, and from which the circular Ligament of the Joint rises. Below the anterior Base two Tubercles stand out: The smaller, which is the interior, has the Tendon of the *subscapularis* Muscle inserted into it. The larger exterior Protuberance is, at its superior Part, divided into three smooth plain Surfaces: Into the anterior of which, the *Musculus supra-spinatus*; into the middle or largest, the *infra-spinatus*; into the posterior, the *Teres minor* is inserted. Between these two Tubercles, exactly in the anterior Part of the Bone, a deep long *Fossa* is formed for lodging the tendinous Head of the *Biceps flexor cubiti*; which, after passing, in a Manner peculiar to itself, through the Cavity of the Articulation, is tied down by a tendinous Sheath running a-

* Ἀγκυκολία, ἄλἐνν, Os brachii, armi, adjutorium, parvum brachium, canna brachii.

* Acrocolium.

across the *Fossa*; in which, and in the neighbouring Tubercles, are several remarkable Holes, which are penetrated by the tendinous and ligamentous Fibres, and by Vessels.

On each Side of this *Fossa*, as it descends *Body*. in the *Os humeri*, a rough Ridge, gently flatned in the Middle, runs from the Roots of the Tubercles: Into the interior the *latissimus Dorsi*, *teres major* and *Coraco-brachialis* are inserted; and into the anterior, the *Pectoralis* terminates. From the posterior Root of the largest Tubercle, such a Ridge also is continued, from which the *Brevis extensor cubiti* rises. The middle interior Surface of this Bone is flatned by the Belly of the *Biceps flexor cubiti*. In the Middle of this plain Surface the Entry of the medullary Artery is seen slanting obliquely downwards; and at the Fore-side of this Plain the Bone rises in a Sort of Ridge, which is rough, and often has a great many small Holes in it. At this Place the Tendon of the strong *Deltoid* Muscle is inserted, on each Side of which the Bone is smooth and flat, where the *Brachialis internus* rises. This particularly is largest on the Outside, behind which a superficial spiral Channel formed by the *Muscular* Nerve, runs from behind forwards and downwards. The posterior Surface of the Body of the *Os humeri* is flatned by the Extensors of the Fore-arm. Near the under Extremity of this Bone, a large sharp Ridge is extended on the external Side between the anterior and posterior Surfaces: From it the *Musculus supinator radii longus*, and the longest Head of the *Extensor carpi radialis* rise. Opposite to this, another
small

small Ridge is found, from a small Deprefion on the anterior Side of which the *Pronator radii teres* rifes.

The Body of this Bone becomes gradually broader towards the inferior Extremity, where it has feveral Proceffes; at the anterior and posterior Root of which are two Cavities *. The anterior is divided by a Ridge into two; the External, which is the leaft, receives the Extremity of the *Radius*; and the Internal receives the *Coronoid* Procefs of the *Ulna* in the Flexions of the Fore-arm, while the posterior deep triangular Cavity lodges the *Olecranon* in the Extensions of that Member. The Bone betwixt thefe two Cavities is preffed fo thin, by the Proceffes of the *Ulna*, as to appear diaphanous. The Sides of the posterior Cavity are ftretched out into two Proceffes, one on each Side of the broad Extremity, thefe are called *Condyles*, from each of which a ftrong Ligament goes out to the Bones of the Fore-arm. The external *Condyle*, which, as *Winflow* (a) obferves, has an oblique Direction alfo forwards in refpect of the internal, when the Arm is in the moft natural Pofture, is equally broad, and has an obtufe fmooth Head rifing from it forwards. From the rough Part of the *Condyle* the inferior Head of the *Bicornis*, the *Extensor digitorum communis*, *Extensor carpi ulnaris*, and fome Part of the *Supinator Radii brevis* take their Rife; and on the fmooth Head the fuperior Extremity of the *Radius*

* *Babriders*.

(a) *Memoires de l'Acad. des Sciences 1722*

Radius plays : Immediately on the Outside of which is a Sinuosity for the Passage of the Muscular Nerve. The internal Condyle is more pointed and protuberant than the external, to give Origin to the *Flexor carpi radialis*, *Pronator radii teres*, *Palmaris longus*, *Flexor digitorum sublimis*, and *Flexor carpi ulnaris*. Between the two Condyles, is the *Trochlea* or Pulley, which consists of two lateral Protuberances and a middle Cavity that are smooth and covered with Cartilage ; when the Fore-arm is extended, the Tendon of the internal *Brachialis* Muscle is lodged in the Fore-part of the Cavity of this Pulley. The external Protuberance, which is much the least, has a sharp Edge behind ; but forwards, this Ridge is obtuse, and only separated from the little Head already described, by a small *Fossa*, in which the conjoined Edges of the *Ulna* and *Radius* move. The internal Protuberance of the Pulley is the largest and highest, and therefore in the Motions of the *Ulna* upon it, that Bone would be inclined outwards ; was it not supported by the *Radius* on that Side. Between this internal Protuberance and Condyle, a Sinuosity may be remarked, where the *ulnar* Nerve passes.

The Substance, and the internal Structure of the *Os humeri* is the same, and the same Way disposed as in other long Bones. Substance,

The superior round Head of this Bone of the Arm is articulated by *Enarthrosis*, with the *Glenoid* Cavity of the *Scapula*, which being superficial, and having long Ligaments, allows a free Articulation,
large

large Motion of this Bone. These Ligaments are however considerably strong: For, besides the common circular one, the Tendons of the Muscles perform the same Office; and thence have by several Authors been described as so many distinct Ligaments. Then the *Acromion* and *Coracoia* Process, with the strong Ligaments stretched betwixt them, secure the Articulation above, where the greatest and most frequent Force is applied, to thrust the Head of the Bone out of its Place. True it is, that below there is not near so strong a Defence to the Articulation; but in the ordinary Positions of the Arm, that is, so long as this Extremity is at an acute Angle with the Trunk of the Body, there cannot be any Force applied at this Place to occasion a Luxation, since the Joint is protected so well above.

The Motions which the Arm enjoys by this Articulation are to every Side, and by the Succession of these different Motions, a Circle may be described: Besides which, the Bone performs a small Rotation round its own *Axis*. But tho' this can be performed by the round Head in all Positions, yet as these vary, the Effects upon the Body of the Bone will be very different: For if the Middle of the Head is the Centre of Rotation, as it is when the Arm hangs down by the Side, the Body of the Bone will only be moved forwards and backwards, because, as *Hippocrates* (a) has remarked, the *Axis* of Motion of the Head is near at right Angles with the Length of the Bone; whereas when the

Arm

(a) De Articulo,

Arm is raised to right Angles with the Trunk of the Body, the Centre of Motion and the Axis of the Bone come to be in the same straight Line, and therefore the Body of the *Os humeri* will perform the same Motion with its Head. The inferior Extremity of the *Os humeri* is articulated with the Bones of the Fore-arm, so as they shall follow all its Motions, while on it they perform their own particular Motions, as shall be afterwards described.

Both Extremities of this Bone are cartilaginous in a new born Infant, *In Infants,* and the large Head with the two Tubercles, and the *Trochlea* with the two *Condyles*, become *Epiphyses* before they are united to the Body of the Bone.

The *FORE-ARM** consists of two long Bones, the *Ulna* *FORE-ARM.* and *Radius*; whose Situation, in respect of each other, is in the least straining, or most natural Position oblique; that is, for Example, the *Ulna* is not directly behind, nor on the Outside of the *Radius*, but in a Middle Situation between these two, and the *Radius* crosses it. But the Situation of these two Bones, and of all the other Bones of the superior Extremity that are not yet described, is frequently altered; and therefore, to shun explanatory Repetitions, I desire it may be now remarked, that in the remaining Account of the superior Extremity, I understand by the Term of Posterior that Part which is in the same Direction with the Back of the Hand; by

* *Cubitus*, αἰχμή, ὀστέον, αὐγών, *Ulna*, *lacertus*,

by anterior, that answering to the Palm; by internal, that on the same Side with the Thumb; by External, the Side nearest the little Finger; supposing the Hand always to be in a middle Position between *Pronation* and *Supination*.

*ULNA**, so named from its being used as a Measure, is the longest of the two Bones of the Fore-arm, and situated on the Out-side of the *Radius*.

Superior Extremity. At the superior Extremity of the *Ulna* are two Processes: The posterior is the largest, and formed like a Hook, whose Concave Surface moves upon the Pulley of the *Os humeri*, and is called *Olecranon*†, or Top of the Cubit: The posterior convex Part of it is rough and scabrous, where the *Longus*, *Brevis* and *Brachieus externus* are inserted. The *Olecranon* makes the Passage of the Tendons of the Muscles over the Extremity of the *Os humeri* unnecessary, which would have been of ill Consequence in the great Flexions of this Joint, or when any considerable external Force is applied to this Part, according to the just Remark of *Winslow* (a). The anterior Process is not so large, nor reaches so high, but is sharper at its Extremity, therefore named *Coronoid*. Between these two Processes, a large semicircular or *sigmoid* Concavity is left; the Surface of which on each Side of a middle Rising, is slanting, and exactly adapted to the Pulley of the

* Cubitus, *ὑψυχος*, *μετρούχλιον*, *Focile majus*. *Can-na* vel *arundo major* & inferior *Brachii*.

† *Ἀγκῶν*, *Gibber*, *Cubitus*, *Additamentum necatum*.

(a) *Exposition Anatomique du Corps humain, Traité des Os* lecs § 979.

the Bone of the Arm. Across the Middle of it a small Sinuosity is stretched for lodging mucilaginous Glands; where, as well as in a small Hollow on the internal Side of it, the Cartilage that lines the rest of its Surface is wanting. Round the Brims of this Concavity the Bone is rough, where the circular Ligament of the Joint is implanted. Immediately below the *Olecranon* a flat triangular spongy Surface appears, on which we commonly lean. At the internal Side of this a larger hollow Surface is found, where the *Musculus Anconæus* is lodged, and the Ridge at the Inside of this gives Rise to the *Musculus supinator radii brevis*. Between the Top of this Ridge and the *coronoid* Process a semilunated smooth Cavity lined with a Cartilage is remarkable, in which the round Head of the *Radius* plays; and immediately below it a rough Hollow gives Lodging to mucilaginous Glands. The anterior Root of the *coronoid* Process is scabrous and unequal where the *Brachialis internus* is inserted; and on the Outside of that we observe a smooth Concavity, where the Beginning of the *Flexor digitorum profundus* sprouts out.

The Body of the *Ulna* is triangular, the internal Angle of which is very sharp, where the Ligament that connects the two Bones is fixed; and the Sides, which make this Angle are flat and rough, by the Action and Adhesion of so many Muscles as are situate here. A little above the Middle of the anterior Surface the Passage of the medullary Vessels is to be remarked slanting upwards. The external Side of this

Y

Bone

Bone is smooth, somewhat convex, and the Angles at each Edge of it are blunted, by the Pressure of the Muscles equally disposed about them.

As this Bone descends it becomes gradually smaller, so that its inferior Extremity terminates in a very little Head, standing on a small Neck. Towards the anterior but external Part of which last, an oblique Ridge runs, that gives Rise to the *Pronator radii quadratus*. The Head is round, smooth and covered with a Cartilage on its internal Side, to be received into the semilunar Cavity of the *Radius*; while from its external Side a *Styloid Process* * stands out, from which a strong Ligament is extended to the *Os pisiforme* and *unciforme* of the Wrist. Between the posterior Extremity of that internal smooth Side and this Process, a Sinuosity is left for the Tendon of the Extensor *carpi ulnaris*; and on the Outside of the Root of the Process, such another Depression may be remarked for the Passage of the *Flexor carpi ulnaris*. The Extremity of the Bone is smooth and covered with a Cartilage, between which and the Bones of the Wrist, a doubly-concave movable Cartilage is interposed, that seems to be the Cartilage which covers the inferior Extremity of the *Radius* continued. At the internal Root of the *Styloid Process*, a small rough Cavity is formed for lodging mucilaginous Glands.

The *Ulna* is articulated above
Articulation. with the inferior Extremity of the
Os

* Γελασίδιον, Malleolus externus.

Os humeri by *Ginglymus*, which allows an easy and secure Extension to near a straight Line with the Arm, and Flexion to a very acute Angle; but by the slanting Position of the Pulley, the inferior Part of the Fore-arm is turned outwards in the Extension and inwards in the Flexion, as *Winslow* (a) has remarked; and also a very small Kind of Rotation is allowed in all Positions, especially when the Ligaments are most relaxed by the Fore-arm being in a middle Degree of Flexion. The *Ulna* is also articulated with the *Radius* and *Carpus*, in a Manner afterwards to be related.

In a Child the *Olecranon* and inferior Head of the *Ulna* are Cartilages, but afterwards become *Epiphyses*; and the *sigmoid* Cavity is not entirely bony at the Birth.

RADIUS *, so called from its imagined Resemblance to a Spoke of a Wheel, or to a Weaver's Beam, is the interior Bone of the Fore-arm. Its superior Extremity is formed into a circular little Head, which is hollowed for an Articulation by *Arthrodia* with the Tubercle at the Side of the Pulley of the *Os humeri*, and the Half of the round Circumference of the Head next to the *Ulna* is smooth, and covered with a Cartilage, to be received into the semilunated Cavity of that Bone. Below the Head, the *Radius* is much smaller; therefore this Part is named its *Cervix*, which is made round by the Action of the *Supinator Radii brevis*: At the

(a) *Memoires de l'Acad. des Sciences* 1722.

* *Κεραὶς*, *ἄσπρηχλον*, *Focile minus*, *Canna minor*, *A-rundo minor*.

the external Root of this Neck, a tuberos Process rises, into the posterior Part of which, the *Biceps flexor cubiti* is inserted. From this, a Ridge runs downwards and inwards, where the *Supinator radii brevis* and *Pronator radii teres* are inserted.

The Body of the *Radius* is not straight, *Body.* but convex on its internal and posterior Surfaces, where it is also round by the equal Pressure of the circumambient Muscles, particularly, of the *Extensors* of the Thumb; but the Surfaces next to the *Ulna* are flattened and rough for the Origin of the Muscles of the Hand, and both terminate in a common sharp Spine, to which the strong Ligament betwixt the two Bones of the Fore-arm is fixed. A little below the Beginning of the anterior plain Surface, where the Flexor Muscle of the last Joint of the Thumb takes its Origin, the Passage of the medullary Vessels is seen slanting upwards. Towards the inferior Extremity, the *Radius* becomes broader and flatter, especially on its anterior Surface, where its *Pronator quadratus* Muscle is situated.

The inferior Extremity is *Inferior Extremity.* larger than the superior, tho' not in such a Disproportion, as the superior Extremity of the *Ulna* is larger than the inferior. The posterior Surface of that tuberos Extremity has a flat strong Ridge in the Middle, and *Fossæ* on each Side: In a small Groove immediately on the Outside of the Ridge, the Tendon of the *Extensor tertii internodii pollicis* plays. In a large one beyond this, the Tendons of the *Indicator* and common *Extensor* Muscles of the Fingers pass

pass, and then contiguous to the *Ulna* is a small Depression made by the *Extensor minimi-digiti*. On the internal Side of the Ridge, there is a broad Depression, which seems again subdivided, where the two Tendons of the *Bicor-nis* or *Extensor carpi radialis* are lodged. The internal Side of this Extremity of the *Radius*, is also hollowed by the Extensors of the first and second Joint of the Thumb; immediately above which, a little rough Surface shows where the *Supinator radii longus* is inserted. The anterior Surface of this Extremity is also depressed, where the Flexors of the Fingers and *Flexor carpi radialis* pass. The external Side is formed into a lunated smooth Cavity, lined with a Cartilage, for receiving the inferior Extremity of the *Ulna*. The Extremity of this Tuberosity is formed into an oblong Cavity, in the Middle of which is a small transverse Rising, gently hollowed, for lodging mucilaginous Glands; while the Rising itself is insinuated into the Conjunction of the two Bones of the Wrist that are here received. The internal Side of this Articulation is fenced by a remarkable Process * of the *Radius*, from which a Ligament goes out to the Wrist, and the *styloid* Process of the *Ulna* guards it on the Outside.

Both Extremities of the Bones of the Fore-arm, are in Children of Children. first Cartilages and then *Epiphyses*, which being larger than the Bodies of these Bones, afford a larger Surface for their Articulations, while a considerable Space must be

* Malleolus internus,

left in the Middle between them, which is supplied by a strong tendinous Membrane, that allows a sufficient Origin to the numerous Muscles, and affords them a Plain to act on, and a Defence from Injuries.

The *Radius* is articulated with
Articulation. the Tubercle of the *Os humeri* by *Enarthrosis*, and therefore is bended and extended along with the *Ulna*, while it may at this Part move round its *Axis* in any Position; and that this last Motion may be sufficiently large, the Ligament is extended farther down than ordinary on the Neck of this Bone, before it is connected to the Bone. This Bone is also joined to the *Ulna* by a double *Enarthrosis*, the *Radius* being received above, and the *Ulna* below; which conjunctly considered form the third Species of *Ginglymus*: But then the Motion performed in these two is very different; for at the superior Extremity, the *Radius* does no more than turn round its *Axis*, while at the inferior, it moves in a certain Sort of *Cycloid*, upon the round Extremity of the *Ulna*; and as the Hand is articulated here with the *Radius* it must move along with it. When the Palm is turned uppermost, the *Radius* is said to perform the *Supination*; when the Back of the Hand is above, it is said to be *Prone*. But then the Quickness and large Extent of these two Motions are assisted by the *Ulna*, which, as was before observed, can move with a kind of small Rotation on the sloping Sides of the Pulley. This lateral Motion, tho' very inconsiderable in the Joint itself, comes to be conspicuous at the inferior Extremity, which, by the strong Ligament
 con-

connecting it to the *Carpus*, will also make the Hand more readily obey these Motions. And *lastly*, when we design a large circular Turn of our Hand, we increase it by the Rotation of the *Os humeri*, and sometimes employ the Spine and inferior Extremities, to make these Motions of Pronation and Supination of the Hand large enough.

The *HAND* * comprehends all from the Joint of the Wrist to the Finger Points, of which it may in general be remarked, that all the posterior Part is convex, for greater Firmness and Strength; and before, it is on the contrary concave, for containing more surely and conveniently such Bodies as we would hold: As also, that one Half has but an obscure Motion, and serves as a Base to the other Half, which is endued with large Motion forwards, but can be extended back very little further than a straight Line. HAND.

As the Bones that compose it are of different Shapes and Uses, while several of them that are adjoining, agree in some general Characteristicks; the Hand is therefore commonly divided into the *Carpus*, *Metacarpus* and *Fingers*, among which the Thumb is reckoned. Divided.

CARPUS † is composed of eight small spongy Bones situated at the upper Part of the Hand. Each of these Bones I shall describe with *Lysenius* (a), under a proper Name taken from their Figure, because

* Ἀρχή, summa Manus.

† Κτεῖς, Brachiale, prima palmæ pars, rasetta.

(a) Cult. Anat. lib. 5. cap. 2.

because the Method of ranging them by Numbers leaves Anatomists too much at Liberty to debate very idly, which ought to be preferred to the first Number: Or, which is worse, several, without explaining the Order they observe, differently apply the same Numbers, and so confound their Readers Ideas. But that the Description of these Bones may be in the same Order with the Generality of Anatomical Books, I shall begin with that Range of Bones, that are concerned in the movable Joint of the Wrist, or are connected to the Fore-arm, and shall afterwards consider the four that support the Thumb and *Ossa metacarpi* of the Fingers.

The eight Bones then of the *Carpus* are, *Os scaphoides*, *lunare*, *cuneiforme*, *pisiforme*, *trapezium*, *trapezoides*, *magnum*, and *unciforme*.

The *Scaphoides* is situated most internally of those that are articulated with the Fore-arm. The *Lunare* is immediately on the Outside of the former. The *Cuneiforme* is placed still more externally, but does not reach so high up as the other two. The *Pisiforme* stands forwards into the Palm from the last. The *Trapezium* is the first of the second Row, and is situated betwixt the *Scaphoides* and first Joint of the Thumb. The *Trapezoides* is immediately on the Outside of the former. The *Os magnum* is still more external, and the *Unciforme* is farthest to the Side of the little Finger.

Scaphoides * is the biggest of the eight except one, situated on the internal Side of the Joint, convex above

* *Κοτυλοειδής*, *Naviculare*,

above, concave below, and oblong: From which small Resemblance of a Boat it has got its Name. Its smooth convex Surface is divided by a rough Middle *Fossa*, which runs obliquely cross it. The superior largest Division is articulated with the *Radius*. Into the *Fossa* the common Ligament of that Joint is fixed; and the inferior Division is conjoined to the *Trapezium* and *Trapezoides*. The Concavity receives more than a Half of the round Head of the *Os magnum*. The external Side of this Hollow is formed into a lunar Plain, to be articulated with the following Bone; and the internal, posterior and anterior Edges are rough, for fixing the Ligaments that connect it to the surrounding Bones.

Os lunare * is situated immediately on the Outside of the former, has a *Os lunare*, smooth-convex superior Surface, by which it is articulated with the *Radius*. The internal Side is in Form of a Crescent, by which it is joined with the former Bone; and from this the Name of this Bone is taken. The inferior Surface is hollow, for receiving Part of the Head of the *Os magnum*. On the Outside of this Cavity is another smooth, but narrow oblong Sinuosity, for receiving the superior Extremity of the *Os unciforme*; without which a small round Convexity is found for its Connexion with the *Os cuneiforme*. Between the great superior Convexity, and the first deep inferior Cavity, is a rough *Fossa*, in which the circular Ligament of the Joint of the Wrist is fixed.

Os

* Lunatum,

Os cuneiforme † is situated on the external and inferior Side of the *Os lunare*. It is broad above, and gradually turns smaller below; which gives it the Resemblance of a Wedge. The superior Surface is almost plain, and included in the Joint of the Wrist, being opposed to the Extremity of the *Ulna*. Below this the cuneiform Bone has a rough *Fossa*, wherein the Ligament of the Articulation of the Wrist is fixed. On the internal Side of this Bone, where it is contiguous to the *lunare*, a smooth slightly concave Surface is formed. Its inferior Surface is oblong, somewhat spiral and concave, for its Connexion with the *Os unciforme*. Near the Middle of its anterior Surface a circular Plain appears, where the *Os pisiforme* is sustained.

*Os pisiforme** is almost spherical, except one circular plain or hollow Surface, that stands on the last Bone, from which its whole Body is prominent forwards into the Palm; and serves for fixing the cross Ligament that defends the Tendons of the Flexors of the Fingers, and the one which proceeds from the Extremity of the *Ulna*. Into this eighth Bone of the Wrist, as it is called by *Galen* (a) and most of our *British* Writers, the *Flexor carpi ulnaris* is inserted; and from it the *Abductor*, and Part of the *Flexor primi internodii minimi digiti*, or rather Flexor of the fourth metacarpal Bone, have their

† Triquetrum.

* Cartilaginosum, subrotundum, rectum,

(a) De usu Part. Lib. 2. Cap. 12.

their Origin; and at the internal Side of it a small Depression is formed, for the Passage of the ulnar Nerve.

Trapezium * is placed above the first Bone of the Thumb, and is *Trapezium*; broad and flat at both anterior and posterior Surfaces; whence it is imagined to resemble a Table. Its superior smooth Surface is slightly hollowed and semicircular, for its Conjunction with the *Os scaphoides*. Its external Side is an oblong concave Square, for receiving the following Bone. The inferior Surface is formed into a Pulley, the two protuberant Sides of which are external and internal. On this Pulley the first Bone of the Thumb is moved. At the external Side of the external Protuberance, a small oblong smooth Surface is formed by the *Os metacarpi indicis*. The anterior Part of the *Trapezium* is prominent in the Palm, and near the external Side has a Sinuosity in it, where the Tendon of the *Flexor carpi radialis* is lodged, on the ligamentous Sheath of which the Tendon of the *Flexor tertii internodii pollicis* plays; and without that, the Bone is more than ordinary scabrous, where the cross anterior Ligament of the Wrist is connected, and the *Abductor* and *Flexor primi internodii pollicis* have their Origin.

Os trapezoides † is the smallest Bone of the Wrist, except the *pisiforme*, situated on the Outside of the former. The Figure of it is an irregular Cube.

* *Os cubiforme, trapezoides, multangulum majus.*

† *Trapezium, multangulum minus.*

Cube. It has a small superior hollow Surface, by which it joins the *scaphoides*; a long convex one internally, where it is contiguous to the *Trapezium*; a small external one, for its Conjunction with the *Os magnum*; and an inferior convex Surface, the anterior and posterior Edges of which are however raised, so that a sort of Pulley is formed at this Place, where it sustains the *Os metacarpi indicis*.

Os magnum †, so called because
Os magnum. it is the largest Bone of the *Carpus*, is oblong, almost square, with a round superior Extremity, and triangular inferior plain one. The round Head is divided by a small Rising, opposite to the Connexion of the *Os scaphoides* and *lunare*, which together form the Cavity for receiving it. On the Inside a short plain Surface joins the *Os magnum* to the *Trapezoides*. On the Outside is a long narrow concave Surface, where it is contiguous to the following Bone. The inferior triangular Extremity, which sustains the metacarpal Bone of the middle Finger, is slightly hollowed, and farther advanced on the internal Side than on the external, having a considerable oblong Depression made on that advanced Inside by the metacarpal Bone of the Fore-finger.

*Os unciforme** has got its Name
Os unciforme. from a thin broad Process that stands out from it forwards into the Palm, and is hollow on its internal Side, for affording a Passage to the Tendons of the Flexors

† Maximum, capitatum,

* Cuneiforme.

Flexors of the Fingers. To this Process also the cross Ligament is fixed, that binds down and defends these Tendons, and the *Flexor* and *Abductor* Muscles of the little Finger rise from it. The superior plain Surface is small and convex to be joined with the *Os lunare*: The internal Side is long and slightly convex adapted to the adjoining *Os magnum*: The external Surface is oblique and irregularly convex to be articulated with the cuneiform Bone: And the inferior Extremity is divided into two concave Surfaces; the external for the metacarpal Bone of the little Finger, and the internal for that of the Ring-finger.

In the Description of the preceding eight Bones, I have only mentioned those plain Surfaces covered with Cartilage, by which they are articulated to each other, or to some other Bones, except in a few Cases, where something extraordinary was to be observed; and have of design omitted the other rough Surfaces, lest by crowding too many Words in the Description of such small Bones, the whole should be unintelligible: While these Parts of the Bones, after mentioning their Figure, may easily enough be understood, if it is observed, that they are generally found only towards the Back or Palm of the Hand, that they are all plain, larger behind than before, and receive the different Ligaments, by which they are either connected to neighbouring Bones, or to one another; for these Ligaments cover all the Bones, and are so accurately applied to them, that, as *Galen* (a)

Z observes,

(a) De usu Part. Lib. 2. Cap. 8,

observes, at first View the whole *Carpus* appears one smooth Bone.

As the posterior Surfaces of these
Figure. Bones are largest, the Figure of the whole conjoined must therefore be convex behind, and concave before; which Concavity is still more increased by the *Os pisiforme*, and Process of the *Os unciforme*, standing inwards on one Side, and the *Trapezium* on the other. The Convexity behind renders the whole Fabrick stronger, where it is most exposed to Injuries; and the large Hollow is necessary before, for a safe Passage to the numerous Tendons of the Fingers. This Figure is likewise secured by the strong cross Ligament stretched from the one Side to the other.

The Substance of these Bones is
Substance. spongy and cellular, but pretty strong in respect of their Bulk.

The three first make an oblong
Articulation. Head, by which they are articulated to the inferior Extremitie of the Bones of the Fore-arm by *Enarthrosis*; and therefore can be moved to all Sides, and by a quick Succession of these Motions, may be moved in a Circle. But then, as the Joint is oblong, and therefore the two Dimensions unequal, no Motion is allowed to the *Carpus* round its Axis, except what it has in the Pronation and Supination along with the *Radius*. The Articulation of the first three Bones of the superior Row, with the Bones of the inferior, is such as allows of Motion, especially backwards and forwards; to the Security and Easiness of which, the *Enarthrosis* of the *Os magnum* with the *scaphoides* and *lunare* contributes

tributes considerably: And the greatest Number of the Muscles that serve for the Motion of the Wrist on the *Radius*, being inserted beyond the Conjunction of the first Row of Bones with the second; act equally on this Articulation as they do on the former; but the Joint formed with the *Radius* being the most easily moved, the first Effect of these Muscles will be on it, and the second Row of the *Carpus* is only moved afterwards. By this means a larger Motion is allowed at the Wrist, than otherwise would; or, if as large Motion had been given to one Articulation, the Angle of Flexion would have been very acute, and the Ligaments must have been longer than was consistent with the Firmness and Security of the Joint. The other Articulations of the Bones here being by nearly plain Surfaces, which I called *Arthrodia*, scarce allow any more Motion, because of the strong connecting Ligaments, than, on the Application of any external Power, to yield a little, and to elude the Force of it; and, on proper Occasions, to render the Back of the Wrist a little more flat, or the Palm more hollow. The Articulations of the Thumb and metacarpal Bones shall be spoke to hereafter.

The Uses of the *Carpus* are, to serve as a Base to the Hand, to protect its Tendons, and to afford it a free large Motion. *Uses.*

All the Bones of the *Carpus* are in a cartilaginous State at the Time of Birth. *Of Infants.*

METACARPUS * consists
Metacarpus. of four Bones, which sustain the
 Fingers. Each Bone is long and
 round, with the Extremities larger than the
 Body. The superior Extremity, which some
 call the Base, is flat and oblong, without any
 considerable Head or Cavity; but is however
 somewhat hollowed, for the Articulation with
 the *Carpus*: And on one or both Sides this Base
 is flatned and smooth, where these Bones are
 contiguous to each other. Their Bodies are
 somewhat round, but from their inferior Ex-
 tremity to near their Middle, are flatned be-
 hind by the Tendons of the Extensors of the
 Fingers. The anterior Surface of these Bo-
 dies is a little concave, especially in their
 Middle; along which a sharp Ridge stands out;
 which separates the *Musculi interossei*, placed
 on each Side of these Bones, which are there
 made flat and plain by these Muscles.

Their inferior Extremities are raised into
 large oblong smooth Heads, whose greatest
 Extent is forwards from the Axis of the Bone.
 At the anterior Root of each of these Heads, one
 or two Tubercles stand out for securing the
 Ligaments of the Joint, and for fixing the Li-
 gaments that go from one metacarpal Bone to
 another, to preserve them from being drawn
 asunder: Round the Heads a rough Ring
 may be remarked, for the circular Ligaments
 of the Joints to be fixed to; and both Sides of
 these Heads are flat, by pressing on each other.
 The Length of these Bones is generally dimi-
 nished

* Κτεῖς, περὶ ἀγρίου, εὐδὲ, ἀνδρὸν, κτερίων. Post-
 brachiale, pectus, palma, pecten.

minished in proportion to their Distance from the Thumb.

The Substance of the metacarpal Bones is common to all the Class of long Bones.

At the time of Birth these Bones are cartilaginous at both Extremities; which, after being ossified, are at last joined to their Bodies, as all *Appendices* are to their respective Bones. *At the Birth.*

Tho' they so far agree, yet they may be distinguished from each other by the following proper Characters. *Distinguished.*

The *Os metacarpi indicis* is generally the longest. Its Base, which is articulated with the *Trapezoides*, is hollow in the Middle. The small Ridge on the internal Side of this oblong Cavity is smaller than the one opposite to it, and is made flat on the Side by the *Trapezium*. The exterior Ridge is also smooth and flat on its Outside; for its Conjunction with the *Os magnum*; immediately below which a semicircular smooth flat Surface shews the Articulation of this Bone to the following one. The posterior Part of this Base is flattened where the long Head of the *Extensor carpi radialis* is inserted, and the Fore-part of the same Base is prominent where the Tendon of the *Flexor carpi radialis* is fixed. The external Side of the Body of this Bone is more hollowed by the Action of Muscles than the internal. The Tubercle at the internal Root of its Head is larger than the external. *Indicis.*

Os metacarpi medii digiti is generally the second in Length, but often it is as long as the former, *Medii digiti.*

sometimes longer; and frequently it only appears to equal the first, by its supporting Base being the farthest advanced. Its Base is a broad superficial Cavity, slanting outwards; the internal posterior Angle of which is so prominent as to have the Appearance of a Process. The internal Side of this Base is made plain in the same Way as the external Side of the former Bone, while its external Side has two hollow circular Surfaces; for joining the following; and between these Surfaces a rough *Fossa* is found, for the Adhesion of a Ligament, and lodging mucilaginous Glands. The shorter Head of the *Bicornis* is inserted into the Back-part of this Base. The two Sides of this Bone are near equally flattened, only the Ridge on the anterior Part of the Body is inclined more externally. The Tubercles at the anterior Root of the Head are equal.

Os metacarpi digiti annularis
Digiti annularis. is at its Base of a semicircular Figure, and convex, for its Conjunction with the *Os unciforme*. On its internal Side are two smooth Convexities and a middle *Fossa*, adapted to the former Bone; and the external Side has a triangular smooth concave Surface, to join it with the following. The anterior Ridge of its Body is situated more to the Outside. The Tubercles near the Head are equal.

Os metacarpi minimi digiti is
Minimi digiti. the smallest and sharpest. Its Base is irregularly convex, and rises slanting outwards. Its internal Side is exactly adapted to the former; but the external has no smooth Surface, because it is not
 conti-

contiguous to any other Bone, but it is prominent where the *Extensor carpi ulnaris* is inserted. As this *Os metacarpi* is furnished with a proper moving Muscle, has the plainest Articulation, is most loosely connected and least confined, it enjoys a much larger Motion than any of the rest; so that the Palm of the Hand may be considerably hollowed by the Advance of this Bone forwards, and by the Prominence of the Thumb opposite to it.

The metatarsal Bones are joined above to the *Ossa carpi* by *Arthro-* *Articulation.*
dia; but several of them having different Surfaces, by which they are contiguous to each other, their Articulation comes under what I called the third Species of *Ginglymus*. The Motion in any of them is not very considerable, but the exterior have more than those that are placed nearer to the Thumb. Their Articulations with the first *Phalanx* of the Fingers is by *Enarthrosis*.

These four Bones by their Length make the Hand very capacious, their anterior Concavity forming the Hollow of the Palm, which can be increased at pleasure by the Motion of the more external of these Bones forwards. The Interstices between them allow some Muscles and their Tendons to pass securely, and afford Origin and Lodging to other Muscles: On their round Heads the Fingers move freely.

The *THUMB* and four *FIN-*
*GER*S are each composed of three *Digiti.*
long Bones, that enjoy a large Motion. The Bones are framed after the same Manner in the different Fingers; but the
Thumb

Thumb differs from them in its Structure, and therefore ought to be considered separately.

The *Thumb* * is situated obliquely in respect of the Fingers, neither opposite directly to them, nor in the same Plain with them. All its Bones are much thicker and stronger in Proportion to their Length: Which was extremely necessary, since the Thumb counteracts all the conjoined Fingers.

The first Bone of the Thumb has its *1st Bone.* Base adapted to the double Pulley of the *Trapezium*: For in viewing it from one Side to the other, it appears convex in the Middle; but when considered from behind forwards it is there concave. The anterior Edge of this Base is produced farther than any other Part; and round the posterior a rough *Fossa* may be seen, for the Connexion of the Ligaments of this Joint. The Body and Head of this Bone are of the same Shape as the *Ossa metacarpi*; only that the Body is shorter, and the Head flatter, with the Tubercles at its anterior Root larger.

The Articulation of this Bone is pretty singular. For tho' it is a *Ginglymus*, yet, by being formed into a double Pulley, it enjoys the Motion of an *Enarthrosis*; only is somewhat more confined and less expeditious, but stronger and more secure, than generally the *Enarthrosis* is.

This Bone of Children is in the same State with the metacarpal Bones.

The

* Ἀντίχειρ, δίκονδυλος, Magnus digitus, promanus.

The second Bone of the Thumb has a large Base formed into an oblong Cavity, whose greatest Length is from one Side to the other. Round it several Tubercles may be remarked, for the Insertion of Ligaments. Its Body is convex, or a half-round behind; but flat before, for lodging the Tendons of the Flexors, which are tied down by ligamentous Sheaths that are fixed on each Side to the Angle at the Edge of this flat Surface. The under Extremity of this second Bone has two lateral round Protuberances, and a middle Cavity, whose greatest Extent of smooth Surface is forwards.

The Articulation and Motion of this second Bone is as singular as of the former. For its superior Extremity is articulated by *Enarthrosis*; yet because of the Strength of its lateral Ligaments, oblong Figure of the Joint itself, and Mobility of the first Joint, it only has the two Motions of a *Ginglymus*, Flexion and Extension, and these are generally much confined.

The third Bone of the Thumb is the smallest, with a large Base, whose great Extent is from one Side to the other. This Base is formed into two Cavities and a middle Protuberance, to be adapted to the Pulley of the former Bone. Its Body is rounded behind, but flatter than in the former Bone, for sustaining the Nails; but is flat and rough before, by the Insertion of the *Flexor tertii internodii*. This Bone becomes gradually smaller, till near the under Extremity, where it is a little enlarged, and has an oval scabrous Edge.

The

The Motion of this third Bone
Articulation. is proper to its Articulation *Ginglymus*.

The orderly Disposition of the
Phalanges Bones of the Fingers into Rows has
digitorum. made them generally obtain the
 Name of three *Phalanges* †; all of
 which are situated with their half-round Sur-
 faces directly backwards, for their greater
 Strength, and the flat concave Part before, for
 taking hold more surely, and for lodging the
 Tendons of the Muscles that move them. The
 Ligaments for keeping down the Tendons of
 the Flexor Muscles are fixed to the Angle that
 is on each Side between the posterior Convexi-
 ty and this anterior Concavity. These Bones
 are smaller, in proportion to their Lengths,
 than the Bones of the Thumb, as was already
 remarked.

The Bones of the first *Phalanx* * of the
 1. Fingers answer to the Description of the
 second Bone of the Thumb; only that the
 Cavity in their Base is not so oblong, nor is
 their Motion on the metacarpal Bones so
 much confined; for they can be moved la-
 terally or circularly, but have no Rotation
 round their Axes.

Both the Extremities of this first
of Children. *Phalanx* is in a cartilaginous State
 at the Birth, and the superior is af-
 terwards affixed in Form of an *Epiphysis*.

The

† Scytalidæ, internodia, scuticula, agmina, acies, con-
 dyli, articuli.

* Περὶ ἑνὸς ὀστέου.

The second Bone ‡ of the Fingers has its Base formed into two lateral Cavities, 2. and a middle Protuberance; while the inferior Extremity has two lateral Protuberances and a middle Cavity; therefore, contrary to any Bone of the Thumb, is joined at both Extremities by *Ginglymus*.

This Bone is in the same Condition with the former in Chil- *Of Infants.*
dren.

The third Bone † differs nothing from the Description of the third Bone of the 3. Thumb, excepting in the general distinguishing Marks; and therefore these two enjoy only Flexion and Extension.

The superior Extremity of this third *Phalanx* is a Cartilage in *At the Birth.*
a ripe Child, and is only an *Epiphyse* after, till the full Growth of the Body.

All the Difference of the *Phalanges* of the several Fingers consists in their Magnitude: The *Distinguished.*
Bones of the *Middle-finger* * being the longest and largest; those of the *Fore-finger* † come next to that. The *Ring-finger* † is the third in Bigness, and the *Little-finger* * is the least. Which Disposition is the best Contrivance for hold-

‡ Κόνδυλοι.

† Μετακόνδυλοι, ῥιζωνύχια.

* Κατααυγών, σφακελῶ, Infamis, impudicus, verpus, famosus, obscenus.

‡ Δεικτικός, indicator, λιχανός, demonstrativus, salutaris.

† Ἱατρικός, ᾠόμεσθ, δακτυλιώτης, ἐπιβάτης, Annularis, medicus, cordis digitus.

* Μύωψ, ὀτίτης, Auricularis, minimus.

holding the largest Bodies; because the longest Fingers are applied to the middle largest Periphery of such Substances as are of a spherical Figure, as was remarked of old by *Galen* (a).

The Advantages we acquire by our superior Extremities, and their several Parts, are so evident in all the common Actions of Life, that they must readily occur to the meanest Capacity; and therefore, without mentioning any of them, I shall proceed to the last Part of the Skeleton: Only, lest I should seem to have forgot the small little Bones at the Joints of the Hand, I desire now to refer to the Description of them, under the common Title of *Sesamoid Bones*, which I have placed after the Bones of the Feet.

Of the inferior Extremities.

INFERIOR EX-
TREMITIES.

THE INFERIOR EXTREMITIES comprehend all those Parts depending from the *Acetabula* of the *Ossa innominata*, and are commonly divided into three Parts, viz. the Thigh, Leg and Foot.

The *THIGH** has only one Bone, which is the longest of the Body, and the largest and strongest of any of the cylindrical Bones. The Situation of it is not perpendicular: For the lower End is inclined considerably inwards; so that the two Knees are

(a) De usu part. lib. 1. cap. 24.

* Μηνίον, Femur, coxa, agis, anchæ os, crûs, femur.

are near contiguous, while there is a considerable Distance between the Thigh-bones above: Which is of good Use to us, since sufficient Space is thereby left for the external Parts of Generation, the two great *Cloacæ* of Urine and *Fæces*, and for the large thick Muscles that move the Thigh inwards; and at the same Time this Position renders our Progression quicker, surer, straighter, and in less Room. For had the Knees been at a Distance from each other, we must, to have made a long Step, have been obliged to describe some Part of a Circle with the Trunk of our Body; and, if one Leg was raised from the Ground, our Centre of Gravity would have been too far from the Base of the other, and we should consequently have been in Hazard of falling; so that our Steps would neither have been straight nor firm, nor would it have been possible to walk in a narrow Path, had our Thigh-bones been otherwise placed. In consequence however of the Weight of the Body bearing so obliquely on the Joint of the Knee by this Situation of the Thigh-bones it is that weakrickety Children become inkneed.

The Superior Extremity of the Thigh-bone is not continued in a straight Line with the Body of it, but is set off obliquely inwards and upwards, whereby the Distance between these two Bones is considerably increased above. When this Extremity first goes off, it is small, but afterwards is formed into a large round *Head**, which is the greater Portion of

Superior Extremity.

A a

a

* Vertebrium.

a Sphere unequally divided. This Head is smooth and covered with a Cartilage to play in the *Acetabulum Ischii*. Towards its inferior internal Part a round rough spongy Pit is observable, where the strong Ligament, which is commonly called the *round* one, but that is of rather an oval Figure in its transverse Sections, is fixed, to be extended from thence to the inferior internal Part of the receiving Cavity, where it is considerably broader than in its Progress to the Head of the Thigh-bone. The *Cervix* of the *Os Femoris* has a great many large Holes, into which the Fibres of the strong Ligament that covers it enter, and are thereby surely united to it; and round the Root of the Neck where it rises from the Bone, a rough Ridge is found, where the circular Ligament of the Articulation is connected. Below the back Part of this Root, the large unequal Protuberance, called the *Trochanter major* * is observable; at the superior Root of which, a Cavity is left for the Insertion of the *Musculus glutæus minimus*; and immediately without that, is another, where the *Pyriformis*, *Marsupialis* and *Gemini* are inserted. On the superior Extremity of this Process is a smooth flat Surface, where the *Glutæus medius* is attached; and without and below that, a large smooth Surface is to be seen for the Insertion of the *Glutæus maximus*. From the posterior Face of the Root of this great *Trochanter*, a rough Ridge runs backwards and downwards, into which the

Qua.

* Γαστήρ, Rotator natis, malum granatum testiculorum.

Quadratus is inserted. In the Hollow, at the internal Side of this Ridge, the *Obturator externus* is implanted; and at its interior Extremity we find a conoid Process called *Trochanter minor* *, into which the *Musculus Psoas*, and *Iliacus internus* are inserted, and the *Pectineus* is implanted into a rough Hollow below the internal Root of it. The Muscles inserted into these two Processes being the principal Instruments of the rotatory Motion of the Thigh, have occasioned the Name of *Trochanters* to the Processes.

The Body of the *Os femoris* is convex on the anterior Part, and made hollow Body. behind by the Action of the Muscles that move upon it, and for the Conveniency of sitting, without bearing so much on these Muscles; and probably the Weight of the Legs depending from the Thighs in that Posture contributes considerably to this Curvature. The anterior Surface is a little flattened above by the Beginning of the *Crureus* Muscle, as it is also below by the *Rectus* and *Crureus*. The external Surface is likewise made flat below by the *Vastus externus*, where it is separated from the former by an obtuse Ridge. The *Vastus internus* depresses a little the internal inferior Surface. The posterior concave Surface has a Ridge rising in its Middle, commonly called *Linea aspera*, into which the *Triceps* is inserted. At the superior Part of it the medullary Vessels enter by a small Hole that runs obliquely upwards, a little above which is a rough *Fossa* or two, where the

A a 2

ten-

* Rotator minor.

tendinous Expansion of the *Glutæus maximus* is fixed. The inferior Extremity of the *Linea aspera* divides into two, stretching to each Side, the long Head of the *Triceps* being inserted into the internal, and the short Head of the *Biceps Flexor Tibiæ* rising from the external. Between these two rough Lines, the Bone is made flat by the large Blood-vessels and Nerves which pass upon it; and near the Extremity of each of these Ridges, a small smooth Protuberance may often be remarked, where the two Heads of the *Musculi Gastrocnemii externi* take their Rise; and the sesamoid Bones described by *Vesalius* (a) sometimes are found.

The inferior Extremity of the *Oss. femoris* is larger than any other Part of it, and formed into a great Protuberance on each Side called its *Condyles*; between which a considerable Cavity is found, especially at the posterior Part. The internal Condyle is longer than the external, which must happen from the oblique Position of this Bone, to give less Obliquity to the Leg. Each of these Processes seems to be divided in its plain smooth Surface. The mark of Division on the external is a Notch, and on the internal a Protuberance. The anterior Part of this Division is formed like a Pulley, the external Side of which is highest. On it the *Rotula* plays. The posterior Part has two oblong large Heads, whose greatest Extent is backwards for the Motion of the *Tibia*; and from the rough Cavity

(a) Lib. 1. cap. 28. & 30.

vity between them; but near the Base of the internal Condyle, the strong Ligament commonly called the *cross* one has its Rise. The Sides of the Condyles are made flat by the Muscles passing along them; and on the back Part of the internal Side a slight *Fossa* seems to be made by the Tendons of the *Gracilis* and *Sartorius*; but on the external a considerable Depression is formed by the *Biceps flexor crucis*. A little farther forward than where these Depressions are on each of the Condyles, the lateral Ligaments of the Joint of the Knee rise out from the *Os femoris*. Round this inferior Extremity of the Thigh-bone, large Holes are found into which the Ligaments for the Security of the Joint are fixed, and Blood-vessels pass to the internal Substance of the Bone.

All the Processes of the *Femur* in new born Children are cartilaginous, and afterwards become small *Apophyses*, with large *Epiphyses*. In Children.

The Thigh-bone is articulated above with the *Acetabulum* of the *Ossa innominata* by *Enarthrosis*, Articulation. and therefore can be moved to every Side, but is restrained in its Motion outwards by the high Brims of the Cavity, and by the round Ligament; for otherwise the Head of the Bone would be frequently thrust out at the Breach of the Brims on the Inside, which allows the Thigh to move considerably inwards. The Body of this Bone enjoys little or no rotatory Motion, tho' the Head most commonly moves round its own Axis, because the oblique Progress of the Neck and Head from

the Bone is such, that the rotatory Motion of the Head can only bring the Body forwards and backwards; nor is this Head, as in the Arm, ever capable of being brought to a straight Direction with the Body; so far however as the Head can move within the Cavity in a Circle backwards and forwards, the rest of the Bone may have a partial Rotation. The *Os femoris* is articulated below to the *Tibia* and *Rotula* by *Ginglymus*.

The *LEG** is composed, according to the common Account, of two Bones, *Tibia* and *Fibula*, tho' it seems to have a very good Title to a third, the *Rotula*; since this, tho' a distinct Bone, bears a strong Analogy to the *Olecranon* or superior great Process of the *Ulna*; therefore I shall rank the *Rotula* with these other two Bones.

TIBIA†, so called from its Resemblance to an old Musical Pipe or Flute, is the long thick triangular Bone, situated at the anterior internal Part of the Leg, and continued in near a straight Line from the Thigh-bone, to support the whole superior Fabrick.

The superior Extremity of the *Tibia* is large, bulbous and spongy, and is divided into two Cavities, by a rough irregular Protuberance ‡, which again is hollow at its most prominent Part, as well as at its posterior and anterior

Base

* *Κνήμα*, *Crus*, *tibia*.

† *Περκνήμιον*, *ἀντικνήμιον*, *focile majus*, *arundo major*, *canna major*, *canna domestica cruris*.

‡ *Διάφυστις*, *ἐξοχή νευροχορδῶδης*, *Tuber*, *Tuberculum*.

Base. The anterior of the two Ligaments that compose the great *Cross* one, is inserted into the Middle Cavity, and the posterior Depression of this irregular Process receives the posterior Ligament. The two broad Cavities at the Sides of this Protuberance are not equal; for the internal is oblong and deep to receive the internal *Condyle* of the Thigh-bone, while the external is more superficial and rounder for the external Condyle. In each of these two Cavities of a recent Subject a semilunar Cartilage is placed; the convex Edge of which is thick, and the Cartilage becomes gradually thinner towards the concave or interior Edge. The Middle of each of these Cartilages is broad, and the Extremities turn narrower and thinner as they approach the middle Protuberance of the *Tibia*. The thick convex Edge of each Cartilage is connected to the circular Ligament of the Articulation, but so near to its Rise from the *Tibia* that the Cartilages are not allowed to change Places far; while the narrow Extremities of these Cartilages becoming almost Ligaments, are fixed at the Insertion of the strong cross Ligament into the *Tibia*, and seem to have their Substance blended with that Ligament; therefore a circular Hole must be left between each Cartilage and the Ligament, in which the most prominent convex Part of each Condyle of the Thigh-bone moves. In the Circumference of these Cavities described, the superior Extremity of the *Tibia* is rough and unequal for the firm Connexion of the Ligaments of the Joint. Immediately below the posterior Edge two rough flattened Protuberances stand out:

In-

Into the internal the Tendon of the *semimembranosus* Muscle is inserted; and some Part of the cross Ligament is fixed to the external. On the Outside of this last Tubercle, a smooth slightly-hollowed Surface is formed by the Action of the *Popliteus* Muscle.

Below the anterior Part of the upper Body. Extremity of the *Tibia*, a considerable rough Protuberance * rises, to which the strong tendinous Ligament of the *Rotula* is fixed. On the internal Side of this, a scabrous Cavity is formed, where the *semi-nervosus*, *gracilis* and *sartorius* Muscles are inserted. Whence Surgeons know at what Part the *Tibia* ought to be sawed through in an Amputation, so as not to have too long and troublesome a Stump, and at the same Time to preserve the Motions of the Leg, by saving the proper moving Muscles. Below the external Edge of this superior Extremity, a circular flat Surface covered in a recent Subject with Cartilage, is found for the Articulation of the *Fibula*. Between which and the anterior Knob is a rough Hollow from which the *Tibialis anticus* and *Extensor digitorum longus* take their Origin. From the smooth flat Surface, a Ridge runs obliquely downwards and inwards, to give Rise to the *Tibialis posticus*. At the Inside of this Ridge, an oblique plain Surface is left, where the *Musculus Popliteus* is inserted, and Part of the *Soleus* has its Origin. The remaining Body of the *Tibia* is triangular, the anterior Angle of which is very sharp, and is commonly called

* Ἀντινήμιον, Anterior Tuber,

led the *Spine* or *Shin* *: This Ridge is not straight, but turns first inwards, then out, and lastly in again. The plain internal Side is smooth and equal, being little subjected to the Actions of Muscles; but the external Side is hollowed above by the *Tibialis anticus*, and below by the *Extensor digitorum longus*, and *Extensor pollicis longus*. The two Angles behind these Sides are rounded by the Action of the Muscles; and the posterior Side comprehended between them, is not so broad as those already mentioned, but is more oblique and flattened by the Action of the *Tibialis posticus* and *Flexor digitorum longus*. Some Way above the Middle of the Bone, the internal Angle terminates, and the Bone is made round, but rough, by the Pressure of the *Musculus soleus*. Near to this, the Passage of the medullary Vessels is seen slanting obliquely downwards in the posterior plain Surface.

The inferior Extremity of the *Tibia* is made hollow, but so as a small Protuberance rises in the Middle. The internal Side of this Cavity, which is smooth, and in a recent Subject is covered with a Cartilage, is produced into a considerable Process, commonly named *Malleolus internus* *, whose Extremity is divided by a Notch, and from it Ligaments are sent out to the Foot. We ought to

*Inferior Ex-
tremity,*

ob-

* "Ακανθα, Spina, crea, linea prima tibiae, angulus acutus.

* Σφυρον, ὠέρον, Talus, clavicula, cavilla interior, cavilla domestica.

observe here with *Winslow (a)*, that this internal *Malleolus* is situated more forwards than the internal Condyle of the superior Extremity of this Bone, which is necessary to be remarked in reducing a Fracture of the Leg. The external Side of this Extremity has a rough irregular semilunar Cavity formed in it, for receiving the inferior Extremity of the *Fibula*. The posterior Side has two lateral Grooves, and a small Middle Protuberance. In the internal Depression, the Tendon of the *Musculus tibialis posticus* is lodged; and in the external, the Tendon of the *Flexor longus digitorum* plays. From the Middle Protuberance ligamentous Sheaths go out for tying down these Tendons.

The Articulations and Motions of the *Tibia* shall be explained, after all the three Bones of the Leg are described.

The two Extremities of the *Tibia* *Of Children.* are Cartilages at the Birth, and become afterwards *Epiphyses*.

*FIBULA** is the small long *Fibula*. Bone, placed on the Outside of the Leg, opposite to the external Angle of the *Tibia*; the Shape of it is irregularly triangular.

The superior Head of the *Fibula* *Superior Ex-* has a superficial circular Cavity *tremity.* formed on its Inside, which in a recent Subject is covered with a Car-

(a) Exposition anatomique des Os secs, § 865.

* Περωνήμιον, perone, Focile minus, arundo minor, canna minor cruris, sura, radius.

Cartilage, but so closely connected to the *Tibia* by Ligaments, as to allow only a small Motion backwards and forewards. This Head is protuberant and rough on its Outside, where the *Musculus Biceps* is inserted; and below its internal posterior Side, a Tubercle may be remarked, that gives Rise to the strong tendinous Part of the *Soleus* Muscle.

The Body of this Bone is a little crooked inwards and backwards, which *Body*. Figure is owing to the Actions of the Muscles; but is still increased to a Fault by careless Nurses holding Children by the Legs. The sharpest Angle of the *Fibula* is anterior; on each Side of which, the Bone is considerably but unequally depressed by the Bellies of the several Muscles that rise from or act upon it; and in old People these Muscles make distinct Sinuosities for themselves: For the posterior Surface is flattened above by the *Soleus*, and is made hollow below by the *Flexor pollicis longus*. The external Surface of this Bone is depressed obliquely from above downwards and backwards by the two *Peronæi*; and the anterior Surface bears the Prints of the *Extensor digitorum longus*, *Nonus Vesalii* and *Extensor pollicis longus*. From the internal Angle the strong Ligament is produced to be continued to the *Tibia* for the Connexion of these two Bones and Origin of several Muscles. The posterior Surface is the plainest and smoothest: In the Middle of it the Passage of the medullary Vessels is seen slanting downwards. I have been particular in remarking with *Havers (a)*, the

(a) Osteolog. nov. Disc. 1,

the Entry and Direction of these Vessels, because in several chirurgical Cases, the Operator had Need to take Care, that they are not opened very near to the Bone, to occasion an obstinate *Hæmorrhagy*. And then there seems to be some particular Design in contriving these Canals, so that the *Os humeri*, *Tibia* and *Fibula* should have them running obliquely down; whereas the *Radius*, *Ulna* and *Os femoris* have them slanting upwards, whereby the Arteries and Nerves, which are sent to these three last Bones, must suffer a considerable Reflexion before they come at the *Cancelli*. The Reason of this Diversity may perhaps be, that the Arteries particularly which are so small within the Bones as to have no strong contractile propelling Force in their Coats, and where they are not assisted by the Action of any moving neighbouring Organ, should have, at least in their Passage through the Bone, a favourable Descent for their Liquids; which, it is evident, they will have in the descending oblique Passages formed for them in the first class of Bones, which are generally depending; and they will also most frequently acquire the like Advantage in the last named Bones, because the Hand in the most natural Posture is higher than the Elbow; and when we sit or ly, the inferior Extremity of the Thigh-bone comes to be at least as high raised as the superior. In standing and walking, or when the Arms are moved, the Blood must indeed ascend as it passes thro' the Bones of the Fore-arm and Thigh; but the Pressure of the Muscles, then in Action, on the Vessels

be-

before they enter the Bones, is sufficient to compensate the Disadvantage of their Course. This Reasoning seems to be still enforced by observing, that this Passage is always in these Bones nearer the superior than the inferior Extremities.

The inferior Extremity of the *Fibula* is extended into a *Inferior Extremity* spongy oblong Head, on the Inside of which is a convex, irregular, and frequently a scabrous Surface, that is received by the external Hollow of the *Tibia*, and so firmly joined to it by a very thin intermediate Cartilage and strong Ligaments, that it scarce can move. Below this, the Extremity of the *Fibula* is stretched out into a coronoid Process, that is smooth, covered with a Cartilage, and contiguous to the Outside of the first Bone of the Foot, the *Astragalus*, to secure the Articulation on that Side. This Process is named *Malleolus externus*. This Process being situated farther back than the internal *Malleolus*, and in an oblique Direction, obliges us naturally to turn the Fore-part of the Foot outwards, as is observed by *Winflow* (a). At its inferior internal Part a spongy Cavity for mucilaginous Glands may be remarked; from its Point Ligaments go out to the Foot, and on the back Part of it is a Sinuosity, made by the Tendons of the *Pernaei* Muscles.

The Conjunction of the superior Extremity with the *Tibia* is by *Arthrodia*, and at the lower End the

B b

Carti-

(a) Memoires de l'Acad. des Sciences 1722.

Cartilage seems to glew the two Bones together, not however so firmly in young People, but that the Motion, at the other Extremity of such a long *Radius* as the *Fibula*, is very observable. In old Subjects I often see the two Bones of the Leg grown together at their inferior Extremities.

The principal Use of this Bone is to *uses.* afford Origin and Insertion to Muscles, the Direction of which may be a little altered on proper Occasions, by its upper Part shuffling backwards and forwards. It likewise helps to make the Articulation of the Foot more secure and firm.

Both Extremities of this Bone are *of Children.* cartilaginous in a ripe Child, and assume the Form of *Appendices* before they are united to the Body of the *Fibula*.

ROTULA * is the small flat *Rotula.* Bone situated at the anterior Part of the Joint of the Knee. Its Shape resembles much the Section of a Heart with its Point downwards. The anterior convex Surface of the *Rotula* is pretty smooth; only several Holes pierce it, into which Fibres of the strong Ligament that is spread over it enter. The posterior Surface is smooth, covered with a Cartilage, and divided by a middle convex Ridge into two Cavities, of which the external is largest; and both are exactly adapted to the Pulley of the *Os femoris*. This plain smooth Surface is surrounded by a rough prominent Edge, to which the circular Ligament adheres:
And

* Ἐπιμυλὶς, μυλακρὶς, κόγχη, ἐπιγονατὶς, πλαγισίδερον, patella, moia, genu, scuti-forme os, cartilaginofum, disciforme, oculus genu.

And below them, the Point of the Bone is scabrous, where the strong tendinous Ligament from the Tubercle of the *Tibia* is fixed. The superior horizontal Part of this Bone is flatned and unequal, where the Tendons of the Extensors of the Leg are inserted.

The Substance of the *Rotula* is cellular, with very thin external firm *Substance*. Plates; but then these *Cellule* are so small, and such a Quantity of Bone is employed in the Formation of this Bone, that scarce any Bone of its Bulk is so strong. Besides, it is all covered over with a thick Ligament, (as was observed this sort of Bones generally is,) to connect its Substance, and is movable to one Side or other; and therefore is sufficiently strong, to resist the Actions of the large Muscles that are inserted into it, or any common external Force applied to it; while a fixed Process, such as the *Olecranon*, would not have been sufficient to bear the whole Weight of our Bodies falling on it, as frequently happens to this Bone, and must have hindred the rotatory Motion of the Leg. Notwithstanding these Precautions to preserve this Bone from such Injuries, yet I have seen such another Case as *Kaysch* (a) mentions, to wit, a transverse Fracture in this Bone, when by the Report of the Patient, and People about him, and by the want of Swelling, Discolouring, or other Mark of Bruise or Contusion, it was plain the Bone was broke by the violent straining Effort of the Muscles. Tho' my Patient recovered the Use of the Joint of the Knee,

B b 2

yet

yet I think it reasonable to believe, that this sort of Fracture should be attended with a Difficulty of Motion, after the broken Parts of the *Rotula* are reunited, because the callous Matter will probably extend itself into the Cavity of the Joint, where it may either grow to some of the Parts, or at best it will make such an Inequality on the posterior Surface of this Bone, as will not allow it to perform the necessary Motions on the Condyles of the *Femur*.

The Articulation of the *Rotula* with the *Os femoris* is a plain *Ginglymus*, and it is connected to the *Tibia* by a strong *Syndesmosis*.

At the ordinary time of Birth the *Rotula* is entirely cartilaginous, and scarce assumes a bony Nature so soon as most *Epiphyses* do.

Now therefore that all the Parts of the Joint of the Knee are described, let us examine what are its Motions, and how performed. The two principal Motions are Flexion and Extension. In the former of these, the Leg may be brought to a very acute Angle with the Thigh, by the Condyles of the Thigh-bones being round and smoothed so far backwards. In performing this, the *Rotula* is pulled down by the *Tibia*. When the Leg is to be extended, the *Rotula* is drawn upwards, and consequently the *Tibia* forwards, by the Extensor-muscles, which by means of the protuberant Joint and this thick Bone with its Ligament, have in effect the Chord with which they act, fixed to the *Tibia* at a considerable Angle, there-

therefore act with Advantage; but are restrained from pulling the Leg farther than to a straight Line with the Thigh, by the posterior cross Ligament, that the Body might be supported by a firm perpendicular Column: For at this time the Thigh and Leg are as little movable as if they were one continued Bone. But when the Joint is a little bended, the *Rotula* is not tightly braced, and the posterior Ligament is relaxed; therefore, considering the superficial Cavities of the *Tibia*, this Bone may be moved a little to either Side, or with a small Rotation; which *Winslow* (a) justly remarks is done by the Motion of the external Cavity backwards and forwards on the internal, which serves as a sort of Axis. Seeing then one Part of the cross Ligament is situated perpendicularly, and the posterior Part is stretched obliquely from the internal Condyle of the Thigh outwards, that posterior Part of the cross Ligament will prevent the Leg's being turned at all inwards; but it could not hinder it from turning outwards almost round, was not that Motion confined by the lateral Ligaments of this Joint, which can yield no great Way. This Rotation of the Leg outwards is of good Advantage to us in crossing our Legs on several necessary Occasions, tho' it is altogether fit this Motion should not be very large, lest Luxations should frequently have happened here. While all these Motions are performing, the only Part of the *Tibia* that moves immediately on the Condyles is only so much

B b 3

as

(a) Exposition Anatomique du corps humain, traité des Os secs, § 276.

as is within the cartilaginous Rings, which by their Thickness on their Outfides make the Cavities of the *Tibia* more horizontal, by raising their external Side where the Surface of the *Tibia* flants downwards. By this Means the Motions of this Joint are more equal and steady than otherwise they would have been. The Cartilages being capable of changing a little their Situation fits them for doing this good Office in the different Motions and Postures of the Member, and likewise contributes to make the Motions larger and quicker. Here then is a farther Proof of the general Rule laid down about movable intervening Cartilages in the Description of the lower Jaw.

The *FOOT* is divided, as well as Foot. the Hand, into three Parts, viz. *Tarsus*, *Metatarsus* and *Toes*; in the Description of which, the several Surfaces shall be named according to the natural Situation, viz. the Broad of the Foot superior, the Sole inferior, the Side of the Great Toe internal, the Little Toe external.

The *Tarsus* * consists of seven spongy Bones; of which the *Astragalus* is the superior, the *Os calcis* posterior, the *Os naviculare* in the Middle, the *Os cuboides* the external of the four anterior; *Os cuneiforme, externum, medium* and *internum*, follow in reckoning inwards. That the Description of these Bones may not be swelled with Repetitions, I desire once for all to observe, That where-ever a rough Ridge is mentioned, without a particular Use assigned, a Ligament is

* *Raffeta.*

is understood to be fixed to it; or where-ever a spongy rough Cavity, Depression or *Fossa* is remarked, without naming its Use, a Ligament is inserted, and mucilaginous Glands are lodged: For such will occur in the Detail of each of these Bones.

Astragalus * is in its superior Part formed into a large smooth Head †, *Astragalus*, which in the Middle is slightly hollowed, and therefore resembles a superficial Pulley, by which it is fitted to the inferior Extremity of the *Tibia*. The internal Side of this Head is flat and smooth, to play on the internal *Malleolus*; and the external Side has also such a Surface, but larger, for its Articulation with the external *Malleolus*. Round the Base of this Head is a rough *Fossa*; and immediately before the Head, as also below its internal smooth Surface, we find a considerable rough Cavity.

The inferior Surface of the *Astragalus* is divided by an irregular deep rough *Fossa*, which at its interior Extremity is narrow, but gradually widens as it stretches obliquely outwards and forwards. The smooth Surface behind this *Fossa* is large, oblong, extended in the same oblique Situation with the *Fossa*; and concave, for its Conjunction with the *Os calcis*. The posterior Edge of this Cavity is produced into two sharp pointed rough Processes, between which is a Depression made by the Tendon of the *Flexor pollicis longus*. The inferior Surface before the *Fossa* is convex, and composed of

* Ἀστράγαλος, Talus, balistæ os, malleolus, chaib, quatrio, os tessaræ, claviculæ, nuciforme,

† Τετράγωνος.

of three distinct smooth Plains The posterior or longest, and the exterior or shortest, are articulated with the Heel-bone; while the internal, which is the most convex of the three, rests and moves upon a cartilaginous Ligament, that is continued from the *Calcaneum* to the *Os scaphoides*. Without which Ligament the *Astragalus* could not be sustained, but would be pressed out of its Place by the great Weight it supports, and the other Bones of the *Tarsus* would be separated. Nor would a Bone be fit here, because it must have been thicker than could conveniently be allowed; otherwise it would break, and would not prove such an easy bending Base, to lessen the Shoke which is given to the Body in leaping, running, &c.

The anterior Part of this Bone is formed into a convex oblong smooth Head, which some call its Process, which is received by the *Os naviculare*. Round the Root of this Head, especially on the superior Surface, a rough *Fossa* may be remarked.

The *Astragalus* is articulated above to the *Tibia* and *Fibula*, which together form one Cavity. Tho' this Articulation is a *Ginglymus*, it is however so loose, and the Prominencies or Cavities so small, as to allow Motions in all Directions. The Flexion and Extension are the most considerable, the other Motions being confined both by the inferior Processes of the *Tibia* and *Fibula*, called *Malleoli*, and by the strong Ligaments which go out from the Points of these Processes to the *Astragalus*. All the Motions performed at this Joint are more evident

dent in the anterior Part of the Foot, this being the Extremity of the *Radius* of the Circle in which the Motion is made. The *Astragalus* is doubly joined: Below, to the *Os calcis*, by the third Species of *Ginglymus*: and before, to the *Os naviculare*, by *Enarthrosis*.

A considerable Share of this Bone is ossified in a new born of Children, Infant.

Calcaneum * is the largest Bone of the seven, situated at the inferior and *Os calcis*. posterior Part of the *Tarsus*. Behind, it is formed into a large Knob, commonly called the *Heel*; the posterior Surface of which is rough where the *Tendo Achillis* is inserted into it; and above, it is hollow and spongy. Farther forwards, on the superior Surface of the *Calcaneum*, is an oblong smooth Convexity, adapted to the posterior Concavity of the *Astragalus*: And beyond this irregular Convexity a narrow *Fossa* is seen, which divides it from two small concave smooth Surfaces, that are joined to the anterior Part of the *Astragalus*. Behind the posterior of these smooth Surfaces, which is the largest, a small Sinuosity is made by the Tendon of the *Flexor digitorum longus*; at the anterior Part of which a small rough Protuberance appears, that gives Rise to the *Musculus extensor digitorum brevis*.

The external Side of this Bone is flat, with a superficial *Fossa* running horizontally, in which the Tendon of the *Musculus peroneus longus* is lodged. The internal Side of the Heel-bone is hollowed, for lodging the Origin
of

* *Os calcis*, πτέγα, calcar pedis.

of the *Massa carnea* Jac. Sylvii, and for the safe Passage of the Nerves and Arteries. Under the Side of the internal smooth Concavity a particular Groove is made by the Tendon of the *Flexor pollicis longus*; and from the thin Protuberance on this internal Side, the cartilaginous Ligament that supports the *Astragalus*, goes out to the *Os naviculare*; on which Ligament, and on the Edge of this Bone to which it is fixed, the Groove is formed for the Tendon of the *Flexor digitorum profundus*.

The inferior Surface of this Bone is pressed flat at the Back-part, by the Weight of our Bodies; and immediately before this Plain there are two Tubercles, from the internal of which the *Musculus abductor pollicis*, and *Flexor digitorum sublimis*, have their Origin; and the *Abductor minimi digiti* rises from the external. Before these Protuberances this Bone is concave, for lodging the Flexor-muscles; and at its anterior Extremity we may observe a rough Depression, from which the Ligament goes out that prevents this Bone to be separated from the *Cuboides*.

The anterior Part of the *Os calcis* is formed into an oblong Pulley-like smooth Surface, which is circular at its superior-external Extremity, but is pointed below. This smooth Surface is fitted to the *Os cuboides*.

A large Share of the Heel-bone of Children. is ossified at the ordinary Time of Birth, and the large Knob appears afterwards in Form of an *Epiphyse*.

Os naviculare *, situated immediately before the *Astragalus*, *Os naviculare*. is somewhat circular. Its posterior Surface is formed into an oblong Concavity, for receiving the round anterior Head of the *Astragalus*. On the superior Surface is a rough *Fossa*. Below, the *Os naviculare* is very unequal and rough, but hollow for the Safety of the Muscles. On its Inside is a pretty large rising Knob, from which the *Abductor pollicis* takes in part its Origin, and the Tendon of the *Tibialis posticus* is inserted into it: And to it two remarkable Ligaments are fixed; the first is the strong one formerly mentioned which supports the *Astragalus*; the second is stretched from this Bone obliquely cross the Foot, to the metatarsal Bones of the middle Toe, and of the Toe next to the little one. On the Outside of the *Os naviculare* is a semicircular smooth Surface, where it is joined to the *Os cuboides*. The anterior Surface of this Bone is all covered with a Cartilage, and divided into three smooth Plains, fitted to the three *Ossa cuneiformia*.

The *Os naviculare* is wholly of Children's Cartilage in a new born Infant.

OS CUBOIDES † is a very irregular Cube, situated immediately before the *Os calcis*. *Os cuboides*. The posterior Surface is an oblong unequal Concavity, adapted to the anterior Part of the *Os calcis*. On the internal Side of this Bone, a very small semicircular smooth Cavity is formed,

* Σκαφοειδής, *Os cymbr.*

† Πολύμορφον, cubiforme, quadratum, grandinosum, varium, tessaræ, multiforme.

formed, to join the *Os naviculare*; immediately before which, an oblong smooth Plain is made by the *Os cuneiforme externum*; and below this, the Bone is hollow and rough. On the internal Side of the inferior Surface, a round Protuberance and *Fossa* are found, where the *Adductor pollicis* has its Origin. On the external Side of this same Surface is a round Knob, covered with a Cartilage; immediately before which, a smooth *Fossa* may be observed, in which the Tendon of the *Peronæus primus* runs obliquely cross the Foot; and on the Knob, the thin flat Cartilage proper to this Muscle plays; in place of which sometimes a Bone is found: More externally than the Knob, a rough Hollow is made, for the strong Ligament stretched betwixt this Bone and the *Os calcis*. The anterior Surface of the *Os cuboides* is flat, smooth and slightly divided into two Plains, for sustaining the *Os metatarsi* of the Little Toe, and of the Toe next to it.

The Ossification of this Bone is
At the Birth. scarce begun at the Birth.

*Os cuneiforme externum**, if we regard its Situation, or *medium* by its Bulk, is much of the Shape of a Wedge, being broad and flat above, with long Sides running obliquely down, and terminating in a sharp Edge. The superior Surface of this Bone is an oblong Square. The posterior is a smooth Triangle, which is not complete at the inferior Angle, and is joined to the *Os naviculare*. - The external Side is divided as it were by a Diagonal; the

* Chalcoideum externum.

the superior posterior Half of which is smooth, for its Conjunction with the *Os cuboides*, and the other is a scabrous Hollow. In the superior anterior Angle of this Surface, a small smooth Impression is made by the *Os metatarsi* of the Toe next the Little one. The internal Side of this Bone has both the anterior and posterior Edges made flat and smooth, the first by the *Os metatarsi* of the Toe next the Great one, and the last by the *Os cuneiforme medium*. The anterior Surface is exactly an oblong Triangle, for sustaining the *Os metatarsi* of the middle Toe.

Os cuneiforme medium, or *minimum*, is still more exactly the Shape of a Wedge than the former. Its internal Side has a flat smooth Surface above and behind, for its Conjunction with the following Bone; with a small rough *Fossa* below; and a considerable Share of it is rough and hollow. The external Side is smooth, and a little hollowed, where it is contiguous to the last described Bone. Both anterior and posterior Surfaces are flat, smooth and triangular for its Articulation with the *Os naviculare* behind, and with the *Os metatarsi* of the Toe next the great one before.

Os cuneiforme maximum, or *internum*, differs from the two former in its Situation, which is more oblique. Besides, the broad thick Part is placed below, and the small thin Point above and outwards; while the inferior broad Surface is concave, for allowing a safe Passage to the Flexors of the great Toe. The posterior Surface of this *Os cuneiforme* is hollow,

low, smooth, and of a circular Figure below, but pointed above. The external Side is also smooth and flat, but divided into two, whose Direction is near at right Angles with each other. With the posterior, that runs obliquely from below forwards and upwards, the *Os cuneiforme minimum* is joined; and with the anterior, whose Direction is longitudinal, the *Os metatarsi* of the Toe next the great One is connected. The anterior Surface of this Bone is semilunar, but flat and smooth, for sustaining the *Os metatarsi* of the great Toe. The internal Side is scabrous, with two remarkable Tubercles below, from which the *Musculus abductor pollicis* rises; and the *Tibialis anticus* is inserted into its superior Part.

The three cuneiform Bones are
At the Birth. all in a cartilaginous State in a
Fœtus of nine Months.

These seven Bones of the *Tarsus*, when
Uses. conjoined, are convex above, and leave a Concavity below, for lodging safely the several Muscles, Tendons and Vessels that ly in the Sole of the Foot, and are, in the same Manner as those of the *Carpus*, all (except some few Parts mentioned in their particular Descriptions) covered over with strong Ligaments, that, by entering the Holes on their Surface, adhere firmly to them; and therefore so tightly connect them to each other, that, notwithstanding the many smooth Surfaces they have all covered with Cartilage, and some of them of the same Shape as if designed for a very movable Articulation, no more Motion is here allowed, than only to prevent too great a Shoke of the Fabrick of the
 Body

Body in walking, leaping, &c. by falling on too solid a Base; which, if it was one continued Bone, would likewise be much more liable to be broke; and to make our Foot accommodate itself to the Surfaces we tread on, by becoming more or less hollow, or by raising either Side. When the Ligaments are too weak, as in some morbid Cases, a very evident Motion of the *Os naviculare* on the *Astragulus* may be observed.

METATARSUS * is composed of five Bones, which *Ossa metatarsi* in their general Characters agree with the metacarpal Bones, but may be distinguished from them by the following Marks. 1. They are longer, thicker and stronger. 2. Their anterior round Extremities are not so broad, and are less in proportion to their Bases. 3. Their Bodies are sharper above, and flatter on the Sides, with their inferior Ridge inclined more to the Outside. 4. The Tubercles at the inferior Roots of the round Heads are larger.

The first or internal metatarsal Bone is easily distinguished from the rest by its Thickness. The one next to it is the longest, and with its sharp Edges almost perpendicular; and the others are shorter and more oblique, as their Situation is more external: Which general Remarks, with the Description I am now to give of each, may learn us to distinguish what Bone, and of which Foot any one is, that can be offered to our Examination.

C c 2

Os

* Στήθος, πῆλιν. Planta, planum, vestigium, solium, pectus, praeordium, pectusculum.

Os Metatarsi Pollicis is by far the *Pollicis*. thickest and strongest, as having much the greatest Weight to sustain. Its Base is oblong, irregularly concave, and of a semilunar Figure, to be adapted to the *Os cuneiforme maximum*. The inferior Edge of this Base is a little prominent and rough, where the Tendon of the *Peronæus primus* Muscle is inserted. On its Outside an oblique circular Depression is made by the following Bone. Its round Head has generally on its Fore-part a middle Ridge, and two oblong Cavities, for the *Ossa sesamoidea*; and on the external Side a Depression is made by the following Bone.

Os metatarsi of the second Toe is *2di digiti*. the longest of the five, with a triangular Base, supported by the *Os cuneiforme medium*, and the external Side produced into a Process, whose Extremity is an oblique smooth Plain, to be joined to the *Os cuneiforme externum*. Near the internal Edge of the Base this Bone has two small Depressions, made by the *Os cuneiforme maximum*, between which is a rough Cavity. Farther forwards we may observe a smooth Protuberance, which is joined to the foregoing Bone. On the Outside of the Base are two oblong smooth Surfaces, for its Articulation with the following Bone; the superior smooth Surface being extended longitudinally, and the inferior perpendicularly; between which is a rough *Fossa*.

Os metatarsi of the middle Toe *Medii digiti*. is the second in Length. Its Base, supported by the *Os cuneiforme externum*, is triangular, but slanting outwards, where

where it ends in a sharp pointed little Process; and the inferior Angle is not completed.

The internal Side of this Base is adapted to the preceding Bone; and the external Side has also two smooth Surfaces covered with Cartilage, but of a different Figure; for the superior is concave, and being round behind, turns smaller as it advances forwards; and the little inferior smooth Surface is convex, and very near the Edge of the Base.

Os metatarsi of the fourth Toe is near as long as the former, with a *4^{ti} digiti* triangular slanting Base joined to the *Os cuboides*, and made round at its external Angle, with one hollow smooth Surface on the Outside, where it is pressed on by the following Bone, and with two on the internal Side, corresponding to the former Bone; behind which, is a long narrow Surface impressed by the *Os cuneiforme externum*.

Os metatarsi of the little Toe is the shortest, situated with its two *Minimi digiti* flat Sides above and below, and with the Ridges laterally. The Base of it, Part of which rests on the *Os cuboides*, is very large; tuberos, and produced into a long pointed Process externally; whence Part of the *Abductor minimi digiti* has its Origin; and into its superior Part the *Peroneus secundus* is inserted. Its Inside has a flat conoidal Surface, where it is adjoining to the preceding Bone.

When we stand, the anterior Extremities of these metatarsal Bones, and the *Ufers* *Os calcis*, are our only Supporters, and therefore it is necessary they should be strong, and

and have a confined Motion, as indeed we see they have.

The Bones of the *TOES* are much *Toes.* of kin to those of the Thumb and Fingers: Particularly the two of the great Toe are precisely formed as the two last of the Thumb; only their Position, in respect of the other Toes, is not oblique, and they are proportionally much stronger, because they are subjected to a greater Force; for on those principally the Weight of the Body is supported, when we are raised on our Tip-toes.

The three Bones in each of the other four differ from those of the Fingers, in these Particulars. They are less, and smaller in Proportion to their Lengths: Their Bases are much larger than the anterior Extremity: Their Bodies are sharper above and below, and flatter on the Sides: The first *Phalanx* is proportionally much longer than the second and third, which are very short.

Of the four, the Toe next the great one, has the largest Bones in all Dimensions, and more externally the Toes are less. The little Toe, and frequently that next to it, have the second and third Bones intimately united into one, which may be owing to their little Motion, and the great Pressure they are subjected to.

The Toes are of good Use to us in *uses.* Walking, by serving as Supporters to the Foot behind, when the Sole is raised, in order to bring our Body, with its Centre of Gravity perpendicular to the advanced Foot.

The Bones of the *Metatarsus* and *In Children.* Toes, are in the same Condition in

in Children as those of the *Metacarpus* and Fingers.

The only Bones now remaining to complete the Description of the Skeleton, are the small ones, which are found in the Hand, Foot, and some other Parts.

OSSA SESAMOIDEA, are the little Bones most frequently found at the Articulations of the Toes and Fingers, which tho' generally said to resemble the Seed of the *Sesamum*, are of very different Figures and Magnitudes. After the Dissection of several of them in recent Subjects, they seem to me nothing else than the Ligaments of the Articulations or the firm Tendons of strong Muscles, or both, become bony, by the violent Compression they suffer in the Situation they are. Thus the *Sesamoid* Bones at the Beginning of the *Gastrocnemii* Muscles, are evidently composed of the tendinous Fibres only. These at the first Joint of the great Toe are as plainly the same continued Substance with the Ligaments and Tendons of the *Abductor*, *flexor brevis*, and *Adductor*, and that, which is sometimes double at the second Joint of that Toe, is Part of the circular Ligament; and indeed if it was worth while to enumerate all of them that are at any Time found, we would observe the whole of them formed in this Manner. Their Number, Figure, Situation and Magnitude are so uncertain, that it were in vain to insist on the Differences of each; and therefore, I shall only in general remark,

1. That wherever the Tendons and Ligaments are firmest. the Actions of the Muscles strong-

strongest, and Compression greatest, there such Bones will be most probably found.

2. That, *ceteris paribus*, the older the Subject is in which they are sought, their Number will be greater, and Size bigger.

3. The more Labour of either, or both Extremities any Person is inured to, he will, *ceteris paribus*, have the most numerous and largest *Ossa sesamoidea*.

However, as the two at the first Joint of the great Toe, are much larger than any other, and are seldom wanting in an Adult, we may judge, that besides the more forcible Cause of their Formation, there should also be some particular Advantage necessary at this Place, rather than elsewhere, which may possibly be, to allow the *Flexor* Muscles to send their Tendons along this Joint, secure from Compression in the Hollow between the two oblong sesamoid Bones, while by removing these Tendons from the Centre of Motion, and giving them the Advantage of an Angle at their Insertion, the Force of the Muscles is increased, and therefore the great superincumbent Weight of our Body in Progression is more easily raised.



APPENDIX.

Of the Marks of a Female Skeleton.

TO finish the Description of the Bones is generally to conclude the *Osteology*, but, that no Part of this Subject might be left untouched, I think it necessary to subjoin the distinguishing Marks of the Male and Female Skeletons, and have chosen to illustrate them in the latter; because, as the Fair Sex have a more delicate Constitution, and are obliged to afford Lodging and Nourishment to their tender *Fœtus*'s till they come to have sufficient Strength and Firmness to bear the Injuries of the Atmosphere, and Contact of other more solid Substances: For these Reasons, I say, the Bones of Women are frequently incomplete, and always of a Make in some Parts of the Body different from those of the robust Male; which agree to the Description already delivered, unless where the proper Specialities of the Female were particularly remarked, which could not be done in all Places where they

they occur, without perplexing the Order of this Treatise: Therefore I chose rather to sum them up here by Way of *Appendix*.

The Causes of the following Specialities of the Female Bones, may be reduced to these three. 1. A weak lax Constitution. 2. A sedentary unactive Life, encreasing that Constitution. 3. A proper Frame for being Mothers.

The Bones of Women are smaller in Proportion to their Length than those of Men, because the Force of their Muscles is not so great, nor is such strong external Force applied to them to prevent their stretching out in Length.

The Depressions, Ridges, scabrous Surfaces and other Inequalities made by the Muscles, are not so conspicuous in them, because their Muscles are neither so thick nor strong, or so much employed to make so strong Prints on their Bones.

Their *Os frontis* is more frequently divided by a Continuation of the *sagittal* Suture, which depends on the first and second general Causes assigned above for the Specialities in their Bones, as will appear after reflecting on the Account given formerly of the Middle internal Spine of this Bone.

Their *Clavicles* are less crooked, because their Arms have been less forcibly pulled forwards, which in our *European* Women, especially those of Distinction, is more hindered by their Garb.

Their *Sternum* is more raised by long Cartilages below, that the *Thorax* might be there widened in some Proportion to what it is shortened

ned by the Pressure upon the *Diaphragm* when they are with Child.

The Defect of Bone, or the Hole in the Middle of the *Sternum*, is oftneft found in them; to allow the Passage of the Mammary Veffels, fay fome; but in my Opinion, this is owing to a lax Constitution, by which the Ossification is not fo soon completed, as where the Action of the Solids is vigorous, and the Circulation of the Fluids is brisk; for a much smaller Hole might have served this Purpose; and the Branches of the internal Mammary Veffels which are sent to the exterior Parts of the *Thorax*, pass out between the Cartilages of the Ribs before these are joined to the *Sternum*.

The *Cartilago Xiphoides*, is oftner bifurcated in Women than Men, for the Reason assigned in the preceding Paragraph, *viz.* a less forcible Power of Ossification.

The superior Cartilages of the Ribs sooner ossify to support the Weight of the *Mammae*.

The middle Cartilages are more flat and broad by the Weight of the Breasts.

The inferior Cartilages are longer for enlarging the Chest.

The *Os sacrum* is more turned outwards for enlarging the *Pelvis*.

Weakly Women, who have born many Children when young, often have the *Vertebrae* of their Back bended forwards, and their *Sternum* depressed; or become as *Cheselden* (a) justly observes, round shouldered and flat breasted by the Pressure and Weight of the im-

(a) Anatomy Book 1. Chap. 2.

impregnated *Uterus*, and by the strong Action of the Abdominal Muscles.

The *Os Coccygis* is more moveable, and less bended forwards, to facilitate the Birth.

The *Ossa Ilium* are more hollow and more reflected outwards, and consequently further removed from each other, in order to widen the inferior Part of their *Abdomen*, and to support better the impregnated *Uterus*.

The Ridge on the upper Part of the *Os pubis* is larger in such Women as have born Children, being extended by the strong Action of the *Musculi recti abdominis*.

The Cartilage between the two *Ossa pubis* is thicker, by which the *Pelvis* is more capacious.

The conjoined Surfaces of the *Ossa pubis*, and of the *Ossa innominata* and *sacrum* are less, that with the straighter *Os sacrum*, a larger Passage might be left for the Exclusion of the Child in Birth.

The great Tuberosity of the *Ossa Ischium* is flatter in Women than Men, because it is more pressed upon in the sedentary Life which Females enjoy.

In consequence of the *Pelvis* of Women being wider, the Articulations of their Thigh-bones must be farther removed from each other; and therefore, as *Albinus* (a) very well remarks, a larger Space is left for the Procreation and Birth of Children. Which Distance of the Thighs, may be one Reason why Women in running generally shuffle more from one Side to the other than Men, to preserve the

(a) De Offib. § 332.

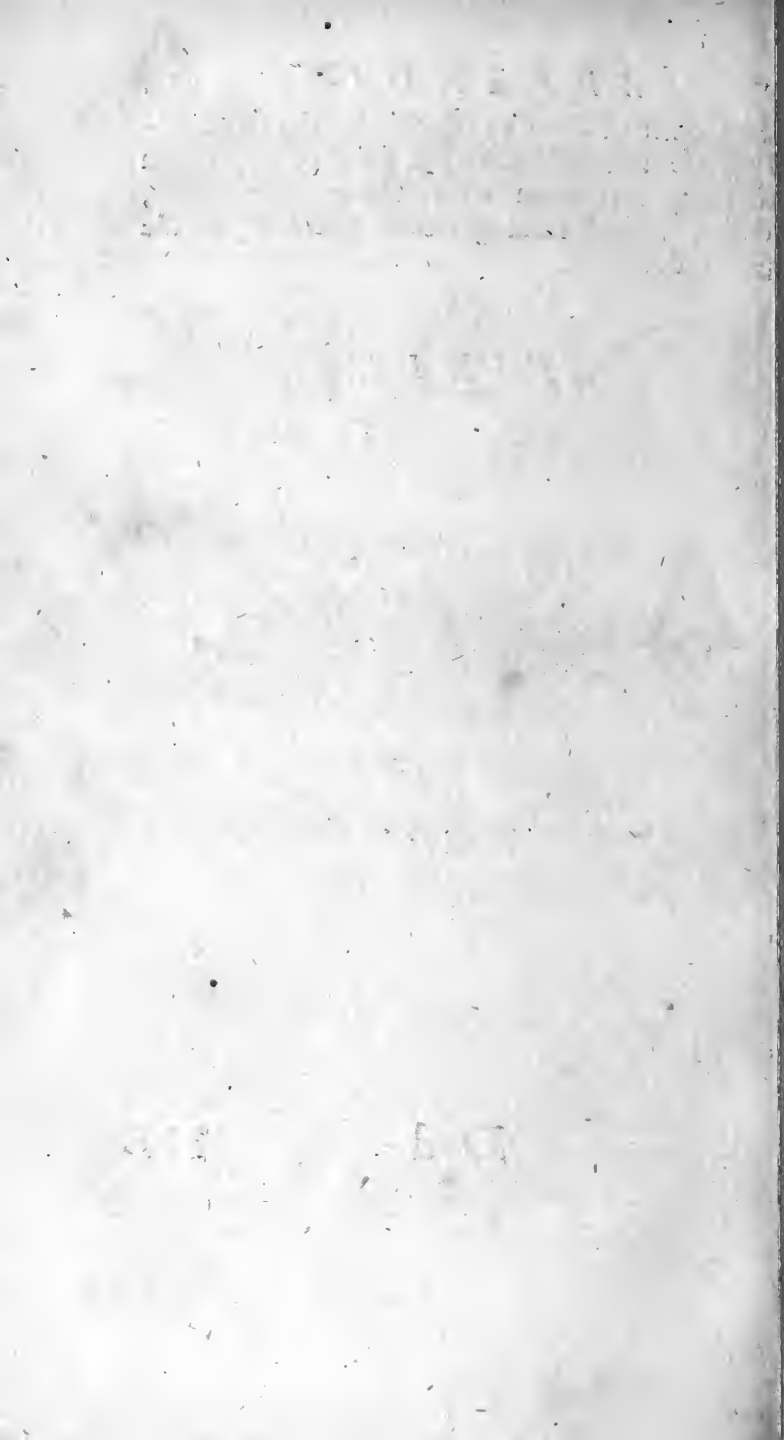
the Centre of Gravity of their Bodies from falling too far to a Side of the Joint of the Thigh that supports them when the other is raised, which would endanger their tumbling to the Ground.

F I N I S.



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F I N I S.

T H E
A N A T O M Y

O F T H E

Human Nerves,

W I T H

An Account of the reciprocal
Motions of the HEART,

A N D

A Description of the HUMAN
LACTEAL SAC and DUCT.

By ALEXANDER MONRO, P. A.

E D I N B U R G H.

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ANATOMY

Human Anatomy

W. H. H.

Professor of Anatomy
University of California

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PREFACE.

THE first Sketch of the following Essays was wrote for the Service of a Friend, without any Intention of mine to have been an Author. When they were published, I was glad of the Opportunity which the second Edition of the Anatomy of the Bones gave me to correct them, and I thought Mr. Winflow's Anatomy made any further Labour of mine on these Subjects unnecessary. But whenever it was foreseen that this third Edition of the Osteology was to be printed, I was teased with the Importunities of Friends and Scholars, to make the Anatomy of the Nerves more complete, and to tack the other two Essays to it. It was in vain for me to plead the Difficulty, if not Impossibility of bringing the Physiology of the Nerves to any Certainty, tho' it might engage me in an endless Dispute; and that any other Description of the Distribution of the Nerves, than what Mr. Winflow had given, was altogether superfluous: They insisted, would not be refused, and forced me to undertake it.

In the Account of the Nerves in general, I have avoided what I could to give Offence; and therefore have not only treated all the Opinions I mention with that Modesty which the Uncertainty of the Subject re-

quired, but have not named one Author, flatter myself, that those, whom I was under the Necessity to redargue, might be better concealed by my not declaring whom I approved.

I attempted an accurate Description of the particular Nerves; but upon comparing the Notes I wrote of what I saw in dissecting the Nerves with Mr. Winslow's Exposition des Nerfs, I found I had done little more than used other Words for describing the same Things; and upon giving my Papers to be perused by some of those for whose Use any Thing I write is chiefly intended, I mean the Students in Physick, I discovered another Misfortune sufficient to make me alter my Design. The young Anatomists were so confounded with the Variety of Branches and their Sub-divisions, that they could not see even the gross Outlines of the Picture I had attempted to draw. That I might be understood, and my Scholars might thereby be assisted to remember the more minute Dissections I shou'd shew them, I changed my Notes into a superficial Description of the larger Branches of the Nerves.

The Account of the Systole and Diastole of the Heart is the immortal Boerhaave's Doctrine illustrated, and the Description of the Receptaculum Chyli, and of the Ductus Thoracicus is nearly the same as it was in the former Edition.



T H E
A N A T O M Y
O F T H E
Human Nerves.

Of the Nerves in general.

1. **B**Y the Assistance of Injections and Microscopes wonderful Plexuses of Blood-vessels are discovered to go from the *Pia Mater* into the *Cortex*, cineritious, or ashy-coloured Part of the *Cerebrum*, *Cerebellum* and *spinal Marrow*, whereas we can only see longitudinal Vessels, without numerous Ramifications or reticular Plexuses, in the white medullary Substance of these Parts.

2. The Continuity of the *Cortex* with the *Medulla* of the *Encephalon* and *spinal Marrow* is observable with the naked Eye, and is more distinctly seen with the Assistance of a Microscope.

A

3. In

2 *Of the Nerves in general.*

3. In dissecting the *Brain* and *Cerebellum*, we see the small Beginnings of the *Medulla* proceeding from the *Cortex*, and can trace its gradual Increase by the Addition of more *Medulla* coming from the *Cortex*.

4. Both *Cortex* and *Medulla* are very succulent; for being exposed to the Air to dry, they lose more of their Weight than most other Parts of the Body do.

5. In several Places we can observe the *Medulla* to be composed of Fibres laid at each other's Sides.

6. The medullary Substance is all employed in forming the white fibrous Cords, which have now the Name of *Nerves* appropriated to them. Within the Skull we see the Nerve to be the medullary substance continued, and the *medulla spinalis* is all employed in forming Nerves.

7. The common Opinion concerning the Rise of the Nerves, founded on a superficial Inspection of those Parts, is, that the Nerves are propagated from the same Side of the *Encephalon* at which they go out. But it having been remarked, after a more strict Enquiry and preparing the Parts by Maceration in Water, that the medullary Fibres decussate or cross each other in some Parts of the *Medulla* as for Example, at the *Corpus annulare*, and Beginning of the *Medulla spinalis*: And practical Observators having related several Examples of People, whose Brain was hurt on one Side, while the morbid Symptom, Palsy appeared on the other Side of the Body, of which I have seen two Instances; and Experiments made on Brutes having confirmed these Observa-

Observations, it has been thought, that the Nerves had their Rise from the Side of the *Encephalon*, opposite to their Egress from the Skull. It may however still be said, that this last Opinion is not fully demonstrated, because a Decussation in some few Parts is not a Proof that it obtains universally; and if there are Examples of Palsy of the Side opposite to where the Lesion of the Brain was, there are also others, where the Injury done to the Brain and the Palsy were both on the same Side.

8. The Nerves are composed of a great many Threads lying parallel; where they come out from the *Medulla*.

This fibrous Texture is evident at the Origin of most of the Nerves within the Skull, and in the *Cauda equina* of the *Medulla spinalis*, we can divide them into such small Threads, that a very quick-sighted Eye can scarce perceive them; but these Threads, when looked at with a Microscope, appear each to be composed of a great Number of smaller Threads.

9. How small one of these Fibrils of the Nerves is we know not, but when we consider that every, even the most minute Part of the Body is sensible, and that this must depend on the Nerves (which all conjoined would not make a Cord of an Inch Diameter) being divided into Branches or Filaments to be dispersed through all these minute Parts, we must be convinced that the nervous Fibrils are very small. From the Examination of the *minimum visibile* it is demonstrated, that each Fibre in the *Retina* of the Eye, or expanded optick Nerve, cannot exceed the Size of the 32400 Part of a Hair.

4 Of the Nerves in general.

10. The medullary Substance, of which the nervous Fibrils are composed, is very tender, and would not be able to resist the common Force of the circulating Fluids, and other such Forces to which the Nerves are exposed within the Bones, were not the *Pia Mater* and *Tunica Arachnoides* continued upon them. The former giving them Firmness and Strength, and the latter furnishing a cellular Coat to connect the Threads of the Nerves, to let them ly soft and moist, and to support the Vessels which go with them.

It is this cellular Substance that is distended with Air when it is blown through a Blow-pipe thrust into a Nerve, and that makes a Nerve appear all spungy, after being distended with Air till it dries, the proper nervous Fibrils shriveling so in drying as they scarce can be observed.

11. These Coats, § 10. would not make the Nerves strong enough to bear the stretching and Pressure they are exposed to in their Course to the different Parts of the Body; and therefore as the Nerves are going out at the Holes in the *Cranium* and *Spine*, the *Dura Mater* is closely wrapt round them, to collect their disgregated Fibres into tense firm Cords, and that the stretching they may be exposed to may have no Effect to hurt them where they are not strengthened thus by the *Dura Mater*; this strong Membrane is firmly fixed to the Sides of the Holes in the Bones through which they pass.

12. The nervous Cords thus composed of nervous Fibrils, cellular Coat, *Pia* and *Dura Mater*, have such numerous Blood-vessels bestowed on them, that after their Arteries only
are

are injected, the whole Cord can be tinged of the Colour of the injected Liquor; and if the Injection is pushed too violently, the cellular Substance of the Nerves comes to be distended with it.

13. A nervous Cord, such as has been just now described, § 12. has very little Elasticity, compared with other Parts of the Body. When cut out of the Body, it does not become observably shorter, while the Blood-vessels contract three Eighths of their Length.

14. In the Course which the Nerves have to the several Parts of the Body, they are generally lodged in a cellular or fatty substance, and run in the Interstices of the Muscles and other active Organs, that so they might be little exposed to the Pressure which these Parts would make upon them, and might be defended from any bad Effects which such Pressure might otherwise produce.

15. The larger Cords of the Nerves divide into Branches in their Distribution to the different Parts; the Branches being smaller than the Trunk from which they come, and making generally an acute angle where they separate.

16. In several Places different Nerves unite into one Cord, which is commonly larger than any of the Nerves which form it.

17. Several Nerves, particularly those which are distributed to the Bowels, suddenly form a hard Knot, considerably larger than all the Nerves of which it is made. These Knots were called *Corpora olivaria*, and are now generally named *Ganglions*.

18. The *Ganglions* have much thicker Coats and larger, more numerous Blood-vessels than

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the Nerves, so that they appear redder and more muscular. On dissecting the *Ganglions*, Fibres are seen running longitudinally in their Axes, and other Fibres are derived from their Sides in an oblique direction to the longitudinal ones.

19. The Nerves which go out from the *Ganglions* are no way remarkably different from other Nerves.

20. The Nerves that are sent to our Organs of the Senses lose there their firm Coats, and terminate in a pulpy Substance. The *optick Nerves* are expanded into the soft tender Webs the *Retinae*; the *auditory Nerve* has scarce the Consistence of *Mucus* in the *Vestibulum*, *Cochlea* and *semicircular Canals* of each Ear; the *Papillae* of the Nose, Tongue and Skin are very soft.

21. The Nerves of Muscles can likewise be traced till they lose their Coats and become very soft, from which, and what we observed of the sensory Nerves, § 20. there is Reason to conclude, that the muscular Nerves are also pulpy at their Terminations, which we cannot indeed prosecute by Dissection.

22. It would seem necessary that the Extremities of the Nerves should continue in this soft flexible State, (§ 20, 21.) in order to perform their Functions right: For in proportion as Parts become rigid and firm by Age, or any other Cause, they lose of their Sensibility, and the Motions are more difficultly performed.

23. Tho' the Fibres in a nervous Cord are firmly connected, and frequently different Nerves join into one Trunk, or into the same *Ganglion*, yet the Sensation of each Part of the Body

Body is so very distinct; and we have so much the Power of moving the Muscles separately, that, if the Nerves are principal Agents in these two Functions, which I shall endeavour to prove they are, we have Reason to believe that there is no Union, Confusion or immediate Communication of the proper nervous Fibrils, but that each Fibre remains distinct from its Origin to its Termination.

24. Changes produced any way upon the Coats of the Nerves cannot however miss to affect the nervous Fibrils. The cellular Substance may be too full of Liquor or may not supply enough; the Liquor may not be of a due Consistence, or it may be preternaturally obstructed and collected. The *Pia Mater* may be too tense or too lax, as may also the *Dura Mater*; their Vessels may be obstructed; their proper Nerves may be violently irritated or lose their Power of acting; and a great many other such Changes may happen which will not only occasion Disorders in particular Nerves, but may cause the *Sympathy* so frequently observed among the Nerves, which is so necessary to be attentively regarded in a great many Diseases in order to discover their true State and Nature, without the Knowledge of which we must commit very dangerous Mistakes in the Practice of Physick and Surgery.

25. Many Experiments and Observations concur in proving, that when Nerves are compressed, cut, or any other way destroyed, the Parts served by such Nerves farther from the Head or Spine than where the injuring Cause has been applied have their Sensations, Motions and Nourishment weakened or lost, while

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no such Effects are seen in the Parts nearer to the Origins of those Nerves ; and in such Experiments where the Cause impeding the Nerves to exert themselves could be removed, and the Structure of the Nerves not injured ; as for Example, when a Ligature made upon a Nerve and stopping its Influence has been taken away, the Motion and Sensation of the Parts soon were restored. From which it would appear that the Nerves are principal Instruments in our Sensations, Motions and Nourishment ; and that this Influence of the Nerves is not inherent in them without the Communication between these Cords, and their Origin is preserved.

It will be no Objection to this Conclusion, that sometimes, upon cutting a Nerve, the Effects above-mentioned have been felt for a short Time, but afterwards the Person was sensible of no Numness or Immobility ; for wherever this is said to have happened, the cut Nerve was only one of several which were sent to the Member, the want of whose Influence would be felt no longer than till the Habit was acquired of performing the Functions easily by the other Nerves.

It is of no greater Weight as an Objection, that when a Ligature is drawn very hard upon a Nerve, the Nerve never again recovers its Influence upon the Parts it is distributed to beyond the Ligature, but is of as little Effect as if it had been cut thro' ; which is to say, that its Texture has been alter'd beyond Recovery. The same Thing is to be seen by tying a Thread tight round a tender Twig of any vegetable, it decays.

26. Experiments and Observations shew too, that when Parts of the *Encephalon* or *Medulla spinalis* have been irritated, compressed or destroyed, the Parts of the Body, whose Nerves had their Origin from such affected Parts of the *Encephalon* or *Medulla spinalis*, became convulsed, paralytick, insensible or wasted; and in such Cases where the injuring Cause could be removed from the Origin of the Nerves, the morbid Symptoms observed in the Parts to which these Nerves were distributed, went off upon the Removal of that Cause. From which it is thought reasonable to conclude, that the Nerves must not only have a Communication with their Origin, but that the Influence they have upon the Parts they are distributed to, depends on the Influence which they derive from the *Medulla Encephali* and *spinalis*.

27. Tho' the *Medulla spinalis* has its own Vessels and cineritious Substance which assists to form its *Medulla*, yet a very large Share of the Medullary Substance within the Spine is derived from the *Encephalon*, whose *Medulla oblongata* descends from the Head, and the Influence of the *Medulla spinalis* on its Nerves depends in a great Measure on this *Medulla oblongata* of the Head. Hence an Injury done to any Part of the *Medulla spinalis* immediately affects all the Parts whose Nerves have their Origin below where the injuring Cause is applied to the Spinal Marrow. A Luxation of a *Vertebra* in the Loins makes the lower Extremities soon paralytick; a transverse Section of the *Medulla* at the first *Vertebra* of the Neck soon puts an End to Life.

28. If such Causes produce constantly such Effects (§ 25, 26, 27,) in us and other Creatures living in nearly the same Circumstances as we do, the Conclusions already made will be good, notwithstanding Examples of Children and other Creatures being born without *Brains* or *Medulla spinalis*; or notwithstanding the Brains of adult Creatures being much changed in their Texture by Diseases, and notwithstanding the Experiments of cutting off the Heads of *Tortoises*, and some other Animals which continued to move about a considerable Time after their Heads were off. We may be ignorant of the particular Circumstances requisite or necessary to the Being or Wellbeing of this or that particular Creature, and we may be unable to account for a great many Phænomena; but we must believe our Eyes in the Examination of Facts, and if we see constantly such Consequences from such Actions, we cannot but conclude the one to be the Cause, and the other the Effect. It would be as unjust to deny the Conclusions made in the three preceeding Articles, because of the seemingly preternatural Phænomena mentioned in the Beginning of this, as it would be to deny the Necessity of the Circulation of the Blood in us and Quadrupeds, because a Frog can jump about or a Tortoise can walk long after all the Bowels of its Thorax and Abdomen are taken out, or because the different Parts of a Worm crawl after it has been cut into a great many Pieces. It is therefore almost universally agreed that the Nerves are principal Instruments in our Sensations, Motion and Nourishment, and that

that the Influence which they have is communicated from their Origin, the *Encephalon* and *Medulla spinallis*; but Authors are far from agreeing about the Manner in which this Influence is communicated, or in what Way Nerves act to produce these Effects.

29. Some alledge that *the nervous Fibres are all solid Cords acting by Elasticity or Vibration*. Others affirm that *those Fibres are small Pipes conveying Liquors, by means of which all their Effects are produced*.

30. The Gentlemen, who think the nervous Fibres solid, raise several Objections to the other Doctrine, which I shall consider afterwards, and endeavour to shew the Fitness of their own Doctrine to account for the Effects commonly observed to be produced by the Nerves.

The Objects of the Senses plainly, say they, make Impulses on the Nerves of the proper Organs, which must shake the nervous Fibrils, and this Vibration must be propagated along the whole Cord to its other Extremity or Origin, as happens in other tense Strings; and these Vibrations being differently modified according to the Difference of the Object, and its different Application, produce the different Ideas we have of Objects.

31. To this Account of the Sensations it is objected, 1st, That Nerves are unfit for Vibrations, because their Extremities, where Objects are applied to them, are quite soft and pappy, (§ 20.) and not susceptible of the Vibrations supposed; and if there could be any little Tremor made here by the Impulse of Objects, it could not be continued along the nervous

vous Cord, because the cellular Substance by which each particular Fibre is connected to the neighbouring ones, (§ 10.) and the fatty Substance in which the nervous Cord is immersed (§ 14) would soon stifle any such vibratory Motion.

The 2^d Objection to this Doctrine is, that, supposing the Nerves capable of Vibrations by the Impressions of Objects, these Vibrations would not answer the Design. For if what we know of other vibrating Strings, to wit, that their Tone remains the same, unless their Texture, Length or Tension is altered, and that different Substances striking them do no more than make the Sound higher or lower: If these Properties are to be applied to Nerves, then it will follow that the same Nerve would constantly convey the same Idea, with no other Variety than of its being weaker or stronger, whatever different Objects were applied to it, unless we suppose the Nerve changed in its Texture, Length or Tension each Time a different Object is applied, which, it is presumed, no Body will undertake to prove does happen. But further, if ever such a Variety of Vibrations could be made, our Sensations would notwithstanding be confused and indistinct, because the tremulous nervous Fibre being firmly connected, and contiguous to several other Fibres of the same Cord, would necessarily shake them too, by which we should have the Notion of the Object as applied at all the different Parts where the Extremities of these Fibres terminate.

32. In whatever way the Favourers of the Doctrine of solid Nerves please to apply the
Elasti-

Elasticity of Nerves to the Contraction of Muscles; their Adversaries insist that Nerves are too weak to resist such Weights as the Muscles sustain, they would surely break, especially that they are greatly, if not wholly, deprived of their strong Coats before they come to the Part of the Muscle, they are immediately to act upon (§ 21.) and the Nerves being found to have little or no Elasticity to shorten themselves (§ 12.) shews them altogether unfit for such an Office as this of contracting Muscles in the way proposed of their acting by Elasticity.

33. As a further Objection against either Motion or Sensation being owing to the Elasticity of the Nerves, it is said, that if this Doctrine was true, the Sensations would be more acute, and the Contractions of Muscles would be greater and stronger, when the Parts become firmer and more rigid by Age; for then their Elasticity is increased: Whereas on the contrary it appears, (§ 22.) that then the Sensations are blunted, and muscular Contraction becomes less and weaker.

34. If the Nerves were granted to be elastic, and to communicate a springy Force to all the Parts they are distributed to, they might appear necessary in this View to assist the Application of the nutritious Particles of the Fluids to the Sides of the Vessels these Particles were to repair; and so far might well enough account for the Share Nerves are thought to have in Nutrition; yet if we cannot make use of Elasticity in the other two Functions of Sensation and Motion, we must also endeavour to find out some other Way the

14 *Of the Nerves in general.*

Nerves act in Nutrition, which will be done afterwards.

35. Having thus stated the Reasons for and against the Nerves acting as solid Strings, let us likewise relate the Arguments for Nerves being Pipes, and the Objections to this Doctrine.

A great Argument of those who think the Nerves to be Tubes conveying Liquors, is the strong Analogy of the Brain and Nerves to other Glands of the Body and their Excretories, where a manifest Secretion of Liquor is made in the Glands to be conveyed by the Excretories, to the proper Places in which it ought to be deposited: They think that the vascular Texture of the Cortex of the *Encephalon* and *Medulla spinalis* (§ 1.); the Continuation of the Cortex in forming the medullary Substance (§ 2. 3.), the fibrous Texture (§ 5.) and succulent State of this *Medulla* (§ 4.), and its being wholly employed to form the Nerves (§ 6.), where the fibrous Texture is evident (§ 8.); all these Things, say they, conspire to shew such a strong Analogy between these Parts and the other Glands of the Body, as carries a Conviction that there is a Liquor secreted in the *Encephalon* and *Medulla spinalis*, to be sent out by the Nerves to the different Parts of the Body.

36. The following Objections are raised to this Argument in favour of a Liquor conveyed in the Nerves, from the Analogy of the Glands. 1st, Other Glands, it is said, have their Excretories collected into a few large Pipes, and not continued in such a great Number of separate Pipes, as far as the Places
where

Of the Nerves in general. 15

where the Liquors are deposited, which last must be the Case, if the Nerves are the Excretories of the glandular Brain. 2dly, We see the Cavities and can examine the Liquors in the Excretories of other Glands much smaller than the Brain, which cannot be done in the Nerves. 3dly, If the Nerves were Pipes, they would be so small that the Attraction of their Sides to their Liquors would be so great, that the Liquors could not be moved with the Celerity required to influence our Sensations and Motions, in the quick Manner we see them performed. 4thly, If the Nerves were Pipes they would be cylindrical ones, and consequently not subject to Diseases, or at least we could have no Comprehension of the Diseases in them.

37. The Answer to the 1st of these Objections is, That there are other Glands where there is a manifest Secretion, and in which the Disposition of the Excretories is in much the same way as in the *Encephalon*; the Kidneys, for Example, have a reticulated Cortex of Vessels, from which the *Eustachian* or *Bellinian Medulla*, consisting of longitudinal Fibres and a few longitudinal Blood Vessels, proceeds; and this *Medulla* is collected into ten or twelve *Papille*, each of which is formed of numerous small separate Pipes, which singly discharge the Urine into the large membranous Tubes, which united compose the *Pelvis*. Upon comparing this Texture of the Kidney with what was said of the *Encephalon*, (§ 1, 2, 3, 4, 5, 6, 8.) the Analogy will be found very strong.

38. In Answer to the 2d Objection in § 36.

it is granted, that Microscopes, Injections, and all the other Arts hitherto employed have not shewn the Cavities of the nervous Fibrils, or the Liquors contained in them; and from what was said (§ 9.) of the smallness of the nervous Fibrils, it is not to be expected that ever they should be seen. But so long as such a Number of little Animals can every Hour be brought to the Framers of this Objection, in which they can as little demonstrate the Vessels or contained Fluids, it will not be allowed to be conclusive Reasoning, that because ocular Demonstration cannot be given of Pipes, therefore they do not exist. For if we have any Notion of an Animal, it is its being a Hydraulick Machine, which has Liquors moving in it as long as it has Life; if therefore such little Animals have Vessels and Liquors which we cannot see, why may not some of the Vessels and Liquors of the human Body be also invisible to us.

To avoid this Answer to the Objection, it is further urged that tho' we might not see the Canals and Liquors of Nerves as they are flowing naturally, yet they ought to discover themselves by the Canals being stretched, or a Nerve's swelling upon being firmly tied; and it might likewise be expected, that however subtile the Liquor of the Nerves is, it might be collected in some Drops at least, when the cut End of a Nerve of a living Animal is kept some Time in the exhausted Receiver of an Air-Pump. It is affirmed, that neither did the tied Nerve swell between the Brain and Ligature, nor was there any Liquor collected in the Receiver of the Air-Pump, from which it

it is concluded that there is no Liquor in the Nerves.

There is some Difference among those who say they have tried these Experiments, some affirming that in young Animals the Nerve does swell above the Ligature, and that a Liquor does drill out upon cutting a Nerve. But allowing the Experiments to succeed any way, the Reply to the Inference from them is, that in neither way are they any thing to the Purpose; for the swelling of the Nerve after it is tied, or the Efflux of Liquors from its Extremity, will never prove either to be the Effect of the Fluid in the proper nervous Fibrils, so long as they might be occasioned by the Liquors in the larger Vessels of the cellular Substance of the Nerves; and if these same Vessels of the Coats of the Nerves do not discover their Liquors by these Experiments, it is far less to be expected that the much more subtile Nerves should.

39. The 3^d Objection to the Doctrine of the Brain being a Gland, and the Nerves its Excretories, supposes a more rapid Motion necessary in the Fluid of the Nerves, than what most of the Defenders of the nervous Fluid will now allow, and is afterwards to be considered particularly in a more proper Place.

40. The 4th Objection being, that if Nerves are Excretories of a Gland, they must be cylindrical Pipes, in which no Obstructions or Diseases would happen; but since we daily see Diseases in the Nerves, they must therefore not be such Excretories. The Answer is, That Diseases happen often in the Excretories of other Glands as of the Liver, Kidneys, &c.

notwithstanding their cylindrical Form, and their much shorter and less exposed Course. When we consider the very tender Substance of the Brain; the vast Complication of Vessels there; the prodigious Smallness of the Pipes going out from it; the many moving Powers which the Nerves are to undergo the shock of; and the many Chances which the Vessels, Membranes and cellular Substance accompanying the Nerves have of being disordered, and then affecting the nervous Fibrils, we have very great Reason to be surprized, that these cylindrical Pipes are not much more frequently put out of Order by too great or too small a Quantity of Liquors; by too viscid or too thin Fluids; by Liquors consisting of too mild and sluggish Particles, or of too acrid pungent ones; by too great or too little Motion given to the Liquors; by the Diameters of the Pipes being too much straitned, or too much enlarged; and by a great many other Varieties of Circumstances which might be supposed capable of disturbing the Functions of the Nerves, supposing them to be cylindrical Excretories of the Gland the Brain.

41. The numerous Vessels of the *Encephalon* have brought some of the Gentlemen who defend the Opinion of the Nerves being solid, to acknowledge, that there is a Liquor secreted in the Brain; but then they will not allow that this Liquor is sent out by the proper nervous Fibrils, but that it is poured into the cellular Substance in which the Nerves ly, to keep them moist and supple, and therefore fit for exerting their Elasticity, Vibration, &c. by

by which, in their Opinion, the Effects commonly ascribed to Nerves are produced.

42. Besides the Objections already mentioned (§ 31, 32,) against the Nerves acting as elastick Strings, this Opinion has some other Difficulties attending it, that may be urged as Objections to it; such as, there is not one Example in the Body of Liquors secreted in a large Gland being poured into a cellular Substance, as here supposed; the Liquors in the Cells of the *tunica cellularis* of other Parts are separated from the little Arteries which are distributed to these Cells.

Further, it can't be well determined, how a Liquor secreted in the *Cortex* of the Brain should make its Way through the *Medulla* to come out into the cellular Membranes on the Surface of that *Medulla*.

Lastly, A very simple Experiment of injecting Water by the Artery of any Member, and thereby filling the cellular Substance of the Nerves of that Member, shews evidently that the Liquor of the *tunica cellularis* of the Nerves has the same Fountain as the Liquor in the *tunica cellularis* has any where else, that is, from the little Arteries dispersed upon it.

43. The Doctrine of a Fluid in the Nerves is not only thus supported by the Analogy of the Brain and Nerves to the other Glands and their Excretories, but those who maintain this Doctrine mention an Experiment which they think directly probative of a Fluid in the Nerves; it is this. After opening the Thorax of a living Dog, catch hold of and press one or both the phrenic Nerves with the Fingers, the *Diaphragm* immediately ceases to

to contract; then let go the hold of the Nerves, and the Muscle acts again: Pinch a second time the Nerve or Nerves some way above the *Diaphragm*, this Muscle again ceases to act: Keep firm the Hold of the Nerve, and with the Fingers of the other Hand strip it down from the gripping Fingers towards the *Diaphragm*, and the Muscle is made to contract; and for three or four such Stripings its Action follows or obeys the Motion of the Fingers which strip it down; then it becomes disobedient, and will contract no more, strip as you will, unless the Fingers gripping or pinching the Nerve let go their Hold, or are removed higher up upon the Nerve, when the Muscle may again be made to contract by stripping the Nerve down towards it. This Experiment I have done with the Success here mentioned. Let any one try if he can imagine any other reasonable Account of these Appearances, than that the gripping Fingers stopt the Course of a Fluid in the Nerve; that what of this Fluid was thus made to stagnate in the Part of the Nerve between the gripping Fingers and *Diaphragm*, was forced down into that Muscle by the Pressure of the Fingers which stripped the Nerve down; and when ever this stagnating Fluid was pressed all away by several Repetitions of stripping the Nerve, the Muscle being supplied with no more Fluid contracted no more, till upon removing the Fingers which had hold of the Nerve, a new Supply of Liquor was brought from the Brain, or from the Part of the Nerve that had not yet been grip'd or stripped; and when ever this Liquor could make its Way down to the Muscle, or was forced
down

down to it, the Muscle immediately began to renew its contractile Motions.

44. Some Gentlemen convinced of the Reasonableness of the Secretion of a Liquor in the Brain to be sent out by the Nerves, but not comprehending how a Fluid could have such a rapid retrograde Motion as they imagined was necessary for conveying the Impressions of Objects made on the Extremities of Nerves to the *Sensorium*, supposed two Sorts of Nerves, one that conveyed a Liquor for muscular Motion and Nutrition; the other composed of solid Nerves, that were to serve for the Organs of the Senses, to convey the Vibrations communicated from Objects to the *Sensorium*.

45. The Objections mentioned (§ 31.) against the sensory Nerves acting by Vibrations take place here: And further, there is nothing in the Texture either of the Brain or Nerves, which gives any Reason to think, that the Nerves are differently formed; on the contrary, the Structure is every where similar, and often Branches of the same Nerve serve both for Sensation and Motion. What occasioned justly a Prejudice against the Scheme of our Sensations depending on a Fluid in the Nerves, to wit, the rapid Refluxes supposed in the sensitive Nerves, is an Opinion now deserted generally by the Defenders of the nervous Fluid, for Reasons to be given in a little, tho' their Opponents are still willing to palm it on them, whereby they may have a better Handle against the general Doctrine of the nervous Fluid.

46. This same rapid Reflux it was too, which gave Rise to another Division of the Nerves into arterious or effluent, and venous or refluxent.

ent. It was said, that muscular Motion and Nutrition depended on the arterious Nerves, and that the Sensations depended on an accelerated Motion of the nervous Fluid towards the Brain, by the Impressions which the Objects of the Senses make upon the venous Nerves. By this Supposition the Absurdity of rapid Fluxes and Refluxes in the same Canal was prevented, and an Advantage was thought to be gained by it, of saving too great a Waste of the Fluid of the Nerves, which otherwise the *Encephalon* and *Medulla spinalis* could not supply in sufficient Quantity to answer all the Exigencies of Life.

47. To this Opinion (§ 46.) it has been objected, 1. That there is no Example in the Body of a secreted Liquor being returned immediately and unmixed to the Gland by which it was originally separated from the Mass of Blood, which would be the Case were there venous Nerves. 2^{dly}, There is no Occasion for saving the Fluid of the Nerves in the Way proposed, the Organs for secreting that Fluid being large enough to supply all that is necessary of it in the common Functions of Life. 3^{dly}, If the Fluid of the Nerves was to be thus kept in a perpetual Circulation, it would soon become too acrid for continuing with safety in such sensible tender Vessels as the Brain and Nerves are composed of. 4^{thly}, This Hypothesis will not answer the Design for which it was proposed. For tho' the momentary Application of an Object might cause an Acceleration in the Fluid of venous Nerves, yet if the Object was kept applied to the Nerves, it would stop their Fluid, so that it could not go for-

forward to the Brain; and therefore, according to this Doctrine, we should be sensible of no Objects, except those whose Application to the Organs of the Senses was momentary.

48. Let us now suppose it probable, that the *Encephalon* and *Medulla spinalis* secern a Liquor from the Blood which is sent into all the Nerves, and that by the Means of this Liquor the Nerves perform the Offices commonly assigned to them, it is necessary to enquire what Kind of Liquor this is, and how it moves, in order to determine how well its Nature and Motion are fitted for performing what is expected from it.

49. It has been supposed, that the Liquor of the Nerves was of a very strong acid or alkaline Nature; but since we can see none of our Juices of such Natures, and since such Liquors irritate and destroy the Parts of the Body they are applied to, we can never imagine that the Brain could separate, or the Nerves could bear any Thing of such an acrid Nature; and this same Tenderness and Sensibility of these Organs must hinder us to suppose the Liquor of the Nerves can be acrid or pungent of any Kind, as of the Nature of inflammable Spirits, Spirit of Harthorn, &c.

50. Some have imagined the Liquor of the Nerves to be capable of vast Explosion, like Gunpowder, or of violent sudden Rarefaction like Air, or of strong Ebullition like boiling Water, or the Mixture of Acids with alkaline Liquors. But as none of the Particles of our Mass of Blood, from which this Liquor of the Nerves must be derived, enjoy any such Properties, we cannot suppose the Blood to furnish

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nish what it has not. Besides, all these Operations are too violent for the Brain or Nerves to bear; and when once they are begun, are not so quickly controuled or put an End to, as Experience teaches us the Nerves can be made to cease from acting.

51. We know not sufficiently the Properties of an *Æther* pervading every Thing, to pretend to apply it to the animal Functions, especially where we must suppose it sent a great Way in a long Cord, in which we cannot conceive how it should be confined; which are Difficulties not to be surmounted in accounting for the Functions of Nerves by Means of such an *Æther*.

52. The surest Way of judging what Kind of Liquor this of the Nerves must be, is to examine the Liquors of similar Parts of the Body. All the Glands separate Liquors from the Blood much thinner than the compound Mass itself; such is the *Liquor* poured into the Cavity of the *Abdomen, Thorax, Ventricles of the Brain, the Saliva, pancreatic Juice, Lymph, &c.* Wherever there is Occasion for secreted Liquors being thick and viscid, in order to answer better the Uses they are intended for, Nature has provided Reservoirs for them to stagnate in, where their thinner Parts may be carried off by the numerous absorbent Veins dispersed on the Sides of those Cavities, or by flying off where there is a Communication with the external Air. The *Snot of the Nose* is very thick commonly by stagnating; but when the Secretion of the Membrane of the Nose is increased by blowing the Nose, or by Sternutatories, we see it very thin and watry; there is
not

not then Time for the Air or Absorbents to carry off the more watry Particles. The *Cerumen* of the Ears is of a watry Consistence, when squeezed out before it has stagnated. The *Mucus* of the alimentary Canal is concocted in *Lacunæ*. The *Bile* in the hepatick Duct is lymphatick; that in the Gall-bladder is viscid and strong. The *Urine* is much more watry as it comes from the Kidneys, than when it is excreted from the Bladder. The *Seed* is thin as it comes from the Testicles, and is concocted in the *Vesicula seminales*, &c.

53. From § 52. we may safely conclude, that the Secretion of a thin Liquor is made in the *Cortex* of the *Encephalon* and *Medulla spinalis*; and seeing the Thinness of secreted Liquors is generally as the Divisions of the Vessels into small subtile Branches, and the Ramifications within the Skull are carried on to a very great Subtily, the Liquor secreted in the *Encephalon* may be determined to be among the finest or thinnest Fluids.

54. Seeing we can observe no large Reservoir, where the Liquor secreted in the *cortical Substance* is deposited, to have its finer Parts taken off, we have Reason to think, that it goes forward into the Nerves in the same Condition in which it is secreted.

55. By fine or subtile animal Liquors is meant no more than those which are very fluid, consisting of a large Proportion of watry Particles, and a lesser one of the oily, saline and terrestrious Particles. Some of the Liquors which we can have in sufficient Quantity to make Experiments with, are so fluid, and have so little Viscidity or Cohesion of Parts,

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that when laid on a Piece of clean Mirrour, they will evaporate without leaving a Stain on the Mirrour, such is the Liquor drilling out on the Surface of the Pleura, the Lymph, and several others.

If then these Liquors, which are subject to our Examination, the discerning Vessels of which are so large that we can see them, have such a small Cohesion of Parts, it might not be unreasonable to say, that the Liquor of the Nerves is as much more fine and fluid than Lymph, as the Vessels separating it are smaller; and therefore that the Fluid of the Nerves is a defecated Water with a very small Proportion of *animal Sapo* dissolved in it.

§6. Two Experiments are said to contradict this Opinion of the Liquor of the Nerves being so fluid and subtile. One is, that upon cutting the *Cauda equina* of a living Animal, a Liquor as viscid as the White of an Egg drops out: The other is, that a wounded Nerve yields a *glairy Sanies*. But these are no Proof that the Liquor of the Nerves is of the same Nature, since it is evident that the Liquor discharged in both these Cases, comes out of the cellular Substance involving the nervous Fibres.

§7. Considering how many Experiments make it evident, that there is a constant uninterrupted Stream of Liquors flowing through all the Canals of Animals, which convey Liquors, whose Particles are not larger than the Diameter of their Canal, which never is the Case in a natural State of excretory Vessels, it is surprizing how the Opinion ever should have been

been taken up of the Liquid of the Nerves being obliged to make such a prodigious rapid Course, as to flow from the Brain to each Muscle instantaneously when we will to contract it; or that this Liquor should flow back with the like Celerity from the Extremity of each Nerve, to which an Object of Sensation was applied. The Nerves, as well as the other Excretories of the Glands are always full of Liquors, the Degree of Distension of the Canals by the Liquors being, even in a sound natural State, sometimes more, and sometimes less, the Sides of the Tubes being stretched to make way for a larger Quantity, and contracting to accommodate themselves to a lesser Quantity; as much Liquor as does Violence to the Sides of the Canals in stretching, or so little as the Sides cannot contract to, both occasion Diseases.

§8. The Motion of the Fluid in the Nerves will not only then be constant, but it will also be equal, or nearly so: For tho' the Blood in the larger Arteries is moved unequally by the unequal Forces, the Contraction of the Ventricle of the Heart, and the weaker Power, the Systole of the Arteries, yet the Difference between these two moving Powers comes to be less and less perceptible, as the Arteries divide into smaller Branches, because of the numerous Resistances the Liquors meet with, and because the Canals they move in become larger, till in the very small arterious Branches there is no Difference in the Velocity of the Liquors from the Effect of the Heart or Arterie. The Motion of the Fluids must still be more equal in the Excretories of Glands,

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and particularly in those where the Vessels have divided into very minute Branches. So that the nervous Fluid will move constantly, equally and slowly for ordinary; but this natural Course may be alter'd by the Influence of the Mind, or by the Pressure of some neighbouring active Organ.

59. We have perhaps no Idea of the Manner how Mind and Body act upon each other; but if we allow that the one is affected by the other, and that the Fluid of the Nerves (whatever Name People please to give it) is a principal Instrument which the Mind makes use of to influence the Actions of the Body, or to inform itself of the Impressions made on the Body, we must allow that the Mind can direct this Instrument differently, particularly as to Quantity and Celerity.

60. Let us now suppose the nervous Fluid such as has been argued for, to wit, an extreme Fluid saponaceous Water, moving in a constant, equal, slow Stream from the *Encephalon* and *Medulla spinalis* in each of the proper nervous Fibres, except when the Motion is changed by some accessory Cause, such as the Mind, Pressure of other Parts, &c. and let us examine how well such a Supposition will agree with the Phænomena of the three great Functions, Nutrition, Sensation and muscular Motion, which the Nerves are principal Instruments of.

In general we may well enough say, that Nerves can carry Fluids to the most minute Part of the Body, to supply what is wasted in any of the solids; that the Impression made by the Objects of the Senses on the very soft pul-

py Extremities of the Nerves of the Organs of the Senses, must make such a Stop in the equal-flowing nervous Fluid; as must instantaneously be perceptible at the Fountain-head from which the pressed Pipes come; That the constant Flow of the Liquor of the Nerves into the Cavities of the *muscular Fibrillæ*, occasions the natural Contraction of Muscles, by the constant *nîsus* it makes to increase the transverse Diameter, and to shorten the longitudinal Diameter of each Fibre, and that it is only to allow the Mind a Power of pouring a greater Quantity of this same Fluid with a greater Velocity, into what muscular Fibres it pleases, to account for the voluntary strong Action of Muscles.

61. But since such a superficial Account would not be satisfactory, it will be expected; that the principal Phænomena of these three Functions are to be explained by the Means of such a Fluid as has been supposed, and that the several Objections against this Doctrine should be answered: Let us attempt this, and where we cannot extricate ourselves from Difficulties which may be thrown in, let us boldly acknowledge Ignorance.

62. α. If Water, with a very small Proportion of Oils and Salts from the Earth, proves a fit Nourishment for Vegetables, such a Liquor as the Fluid of the Nerves has been described (§ 55.) may not be unfit for repairing the Waste in Animals.

β. The slow constant Motion of this nervous Fluid (§ 57, 58.) to the most minute Parts of the Body (§ 9.) is well enough calculated to supply the Particles that are con-

stantly carried away from the Solids by the *Vis Vita*, Circulation of the Liquors and necessary Actions of Life.

γ. The greater proportional Size of the *Encephalon*, the great Fountain of this nutritious Liquor of the Nerves, in Creatures the younger they are, seems very well calculated for their greater proportional Growth at that time of Life.

δ. A Palsy and Atrophy of the Members generally accompanying each other, shew, that Nourishment, Sensation and Motion do depend on the same Cause.

ε. It was said (§ 25.) that the Nerves were *principal* Instruments in Nutrition, it was not affirmed, that they were the *sole* Instruments; and therefore an *Atrophy* may proceed from the Compression or other Lesion of an Artery, without being an Objection to the Doctrine here laid down.

63. a. All Objects of our Senses act by Impulse, when they are applied to their proper Organs. Tangible Objects evidently press on the Surface of our Bodies: Odorous Particles need the Assistance of Air moved rapidly to affect our Nose: Sapid Substances often are not sufficient to give us any Idea of their Taste by their own Weight, but need the Assistance of the Pressure of the Tongue upon the Palate: The Rays of Light collected into a *Focus* drive light Bodies before them: Sound communicates a Vibration to all Bodies in harmonic Proportion with it. The Impulse made thus by any of these Objects on the soft pulpy Nerves (§ 20.) which are full of Liquor, will press their Sides or Extremities, and their Li-
quor

quor will be hindred to flow so freely as it did. The Canals being all full, (§ 57.) this Resistance must instantaneously affect the whole Canals that are pressed and their Origins, and have the same Effect, as if the Impulse had been made upon the Origin itself. To illustrate this by a gross Comparison, let any one push Water out of a Syringe through a long flexible Pipe, fixed to the Syringe, he will be sensible of Resistance, or a Push backwards instantaneously, as any other puts his Finger on the Orifice of the Pipe, or grips the Sides of it. This Impulse made on the Nerves, and thus communicated to their Origin, will vary according to the Strength or Weakness, the Quickness or Slowness, the Continuance or speedy Removal, the Uniformity or Irregularity, the Constancy or Alteration, &c. of the Application of the Objects to the Nerves.

b. Whenever the Impulse proper to the Object is regularly applied with due Force to a Nerve rightly disposed to be impressed by it, and is communicated, as just now explained, to the *Sensorium*, it gives a true and just Idea of the Object to the Mind.

c. The various Kinds of Impulses, which the different Classes of Objects make, occasion a Necessity of having the different Organs of the Senses variously modified, so that the several Impulses may be regularly applied to the Nerves in each Organ, or in other Words, we must have different Organs of the Senses fitted to the different Classes of Objects.

d. As the Objects have one common Property of Impulse, so all the Organs have most of the Properties of the Organ of Touching in common

common with the *Papillæ* of the Skin. In the Nose and Tongue this is evident; in some Operations on the Eyes we can also perceive this, as we may likewise do in some Cases, where Matter is collected in the internal Ear.

e. These Properties common as well in the Objects as the Organs, occasion frequently uncommon Effects in the Application of an Object to an Organ proper to another Object of Sensation; for sometimes we have the same Idea, as if the Object had been applied to its own proper Organ; at other times the Object is as it were changed, and we have the Idea as if the Organ had had its own proper Object applied to it. Thus, for Example, Light is the proper Object to be applied to the Eye, to give us any Idea of Colours; yet when all Light is excluded from the Eyes, an Idea of Light and Colours may be excited in us by Coughing, Sneezing, Rubbing, or striking the Eye-ball.— A Cane vibrating by a Stroke, but not so as to give any Sound perceptible to the Ear, if it is applied to the Teeth, it raises a strong Idea of Sound, as will also a little Insect crawling in the *Meatus auditorius*.— The Fingers applied to two rough Surfaces, rubbing on each other, are sensible of the Sound they make; Surgeons of any Practice in the Cure of fractured Bones can bear Witness to the Truth of this.— The Fingers dipped in acid and several other acrid Liquors, have a Sensation very like to Tasting.— Smelling and Tasting every Body knows are subservient and assisting to each other. From such Examples we have further Proof of one general Cause of our Sensations, to wit, Impulse from

from the Objects; and that any one of the Organs would be capable of producing the Effect of another, if the Impulses of the different Objects could be regularly applied to each.

f. If the Impulse of an Object is applied with due Force, but irregularly, a confused Idea of the Object is raised. Distant Objects are confus'd to *Myopes*, as very near ones are to *Presbytae*.

g. If the Application of the Impulse is regular, but the Force with which it is applied is too weak, our Perception of the Object is too faint. One may whisper so low as not to be heard.

h. If the Application of Objects is too violent, and there is any Danger of the tender Organs of our Senses being lesed or destroyed, the uneasy Sensation we call *Pain* is raised, whatever the Organ thus lesed is. The Objects of Touch affect every Organ: Thus Pressure, cutting, pricking, Salts, pungent Oils, great Heat, violent Cold, &c. occasion Pain, wherever they are applied. Besides this, every particular Organ can be affected with Pain, by the too violent Application of its own proper Object. Too much Light pains the Eyes; very loud Sound stuns the Ears; very odorous Bodies and too sapid Objects hurt the Nose and Tongue. A pretty sure Proof this of the Objects of our Senses all acting, and of the Organs all being impressed in nearly the same Way.

i. Whenever this uneasy Sensation, *Pain*, is thus raised, a Sort of Necessity is as it were imposed upon the Mind, to endeavour to get free of the injuring Cause, by either withdrawing

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ing the leſed Part of the Body from it, as one retires his Hand when his Finger is pricked or burnt; or the injuring Cauſe is endeavoured to be forced from the Body, as a *Teneſmus* pushes acrid *Fæces* out of the *rectum*. In both theſe Operations a convulſive Contraction is immediately made in the leſed Part, or in the Neighbourhood of it; and if the Irritation is very ſtrong or permanent, the greater Part of the nervous System comes to be affected in that ſpaſmodic or convulſive Way.

This *Niſus* of the Mind to free the Body of what is in Danger of being very hurtful, may ſerve to explain the Phænomena of a great many Diſeaſes, when we are acquainted with the Diſtribution of the particular Nerves; and from this we can underſtand the Operation of Medicines that ſtimulate, and may learn how by exciting a ſharp but momentary Pain, we may free the Body of another Pain that would be more durable; and that by having it thus in our Power to determine a flow of the Liquor of the Nerves to any particular Part, for the Benefit of that Part or the Relief of any other diſeaſed Part, we can do conſiderable Service by a right Application of the proper Medicines.

k. If a Pain-giving Cauſe is very violent, or long continued, it deſtroys the Organs either irrecoverably, or puts them ſo much out of Order, that they only gradually recover. People have been made blind or deaf for all their Lives after, by the violent Effect of Light on their Eyes or Sound on their Ears, and we are frequently expoſed to as much Light and Sound as make us unfit to ſee or hear for a con-

considerable Time after. I would explain this by a Ligature put round the tender Branch of an Herb; this Ligature drawn to a certain Degree may weaken the Canals so as to be unfit for the Circulation of the Juices a good While, till they are gradually explicated and made firm by these Juices. A stricter Ligature would disorder the Structure of the Fibres so much, that the Liquors could not recover them. The Analogy is so plain it needs no Commentary.

64. 1. In applying the Fluid of the Nerves to the Action of Muscles, it was said that natural or involuntary Contraction of Muscles was the *Nisus* which the nervous Fluid flowing constantly into the muscular Fibres makes to distend these Fibrils, by enlarging their transverse Diameters and shortning their Axes, and that voluntary Contraction was owing to a greater Quantity of that nervous Liquor determined towards the Muscle to be put in Action, and poured with a greater *momentum* into the muscular Fibrils by the Power of the Mind willing to make such a Muscle to act.

2. It has been objected to this account of muscular Motion, that if it was true, the Volume of a Muscle in Contraction necessarily would be considerably increased by so much Liquor poured into its Fibrils, whereas it does not appear by any Experiment, that the Volume of a Muscle is increased by its being put into Action.

3. To this it has been answered, That the Spaces between the muscular Fibres are sufficient to allow the Fibrils swelling during the Contraction of a Muscle to lodge in, without
any

any Addition to the Bulk of the Muscle; and that it plainly appears that these Spaces between the Fibrils are thus occupied, by the Compression which the larger Vessels of Muscles, which run in those Spaces, suffer during the Action of a Muscle; it is so great that the Muscle becomes pale by contracting.

4. Another Objection to the Action of Muscles being owing to the Influx of a Fluid into their Fibrils is, that muscular Fibres are distractile, or capable of being stretched; and therefore when a Fluid is poured into their hollow Fibrils, they would be stretched longitudinally, as well as have their transverse Diameters increased, that is, a Muscle would become longer as well as thicker when it is put in Action, whereas it is known to every Body that a Muscle is shortned when acting.

5. In Answer to this it has been remarked, that tho' muscular Fibrils are distractile, yet they will not yield to, or be stretched by every Force however little that might be applied to them, a Cord that can be stretched in Length by the Weight of a Pound or two, might not yield in the least to an Ounce or two; and it must likewise be observed, that gradually as any Body is stretched, its Resistance to the stretching force increases. A Rope may be stretched to a certain Length by a Pound Weight appended to it, which would require two Pounds to stretch it very little further; and therefore the general Observation of Animal Fibres being distractile, cannot be a reasonable Objection to the account of muscular Motion above-mentioned, unless a Proof is brought that the Force which the Liquid of the

the Nerves must exert upon each Fibre of a Muscle in order to make a Muscle act, is capable of distracting or stretching the Fibres, which has not yet been attempted to be proved.

6. If muscular Motion depends on the Influx of the nervous Liquid, the instantaneous Contraction of a Muscle, when the Mind wills to make it act, will easily be understood from the Nerves being always full of their Liquor, (§ 57.)

7. If either the Nerves of any Muscle do not furnish a sufficient Quantity of their Liquor, or if the Fibres of a Muscle become too easily distractile, such a Muscle will be unactive or paralytick.

8. If too great a Quantity of the Liquor of the Nerves is determined to a Muscle or Muscles, by any Cause which the Mind cannot command, such Muscle or Muscles will be convulsed.

9. If the Motion of the Liquid of the Nerves is not uniform, but by Disease becomes irregular, an alternate Relaxation and Contraction of Muscles may be the Consequence, hence trembling Palsies, *chorea sancti Viti*, &c.

10. Tho' the Nerves may not furnish as much Liquor as may be sufficient to make Muscles contract with Strength enough to overcome the Resistances to their Action, yet there may be enough of Liquor in the Nerves to allow the Impressions of Objects to be conveyed to the *sensorium*; this may be one Cause of a Member's being sometimes sensible after it cannot be moved.

11. Unless the Liquor of the Nerves acquires some Energy in the Brain, which we
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have no Reason to think the Circulation of the Fluids in the Vessels can give it; or unless it has Properties other than what we can discover in it, or unless there is an active Agent determining its *momentum* towards some particular Parts, which we are not conscious of; if some of these don't obtain the Action of the Heart continuing of equal Force to propel our Liquors, notwithstanding all the Resistances that are to it, is not to be explained.

12. All Muscles, but especially the Heart, will continue to contract in an irregular Way; after they are cut away from the Animal to whom they belonged, which may be owing to the Liquors continuing to flow in the small Vessels, and being poured irregularly into the muscular *Fibrille*.

13. After the Heart or any other Muscle cut away from an Animal has ceased to contract, its Contraction may again be restored by blowing one's warm Breath upon it, or pricking it with any sharp Instrument; that Heat or Pricking should by their *stimulus* (§63. 1.) occasion Contraction in a living Creature may be understood; but how they should have the same Effect in a Muscle separated from an Animal, I know not.

N. B. Num. 11, 12, 13 are as inexplicable upon any other Supposition yet made concerning muscular Motion.

65. I know no Experiment or Observations by which any Thing can be proved, or from which any Thing can be reasonably inferred concerning the Uses of the *Ganglions* of the Nerves, and therefore pretend to give no Account of them.

Of the particular Nerves.

THERE are generally said to be forty Pair of Nerves in all, of which ten come out from the *Encephalon*, and the other thirty have their Origin from the *Medulla spinalis*.

Of the ten Pair of Nerves that are generally said to come from the *Encephalon*, the first is the *OLFACTORY*, which long had the Name of the *Mammillary Processes* of the Brain, because in the Brutes which were most commonly dissected, their Form has some Resemblance to a Nipple; for they are large where they begin to go out from the Brain, and taper a little as they go forwards to the cribriform Part of the *Ethmoid* Bone; and because in these Animals they are evidently Continuations or Productions of the two anterior Ventricles of the Brain, being hollow and containing Lymph, the Antients believed that these Nerves served to convey the superfluous *Mucus* from the cold moist Brain, to be evacuated by the Holes of the cribriform Bone into the Nose. But in Man these Nerves are small, long, and without any Cavity, having their Origin from the *corpora striata*, near the Part where the internal carotid Arteries are about to send off their Branches to the different Parts of the Brain, and in their Course under the anterior Lobes of the Brain, which have a Depression made for lodging them, the human olfactory Nerves become larger till they come to the cribriform Bone where they split into a great Number of small Filaments to pass thro' the little Holes in that Bone, and

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then each being joined by a Branch of the fifth Pair of Nerves is spread on the Membrane of the Nose.

The tender Structure and sudden Expansion of these Nerves on such a large Surface render it impossible to trace them far; which has made some Authors deny them to be Nerves: But when we break the Circumference of the *cribriform Lamella*, and then gently raise it, we may see the Distribution of the Nerves some way on the Membrane of the Nose.

The Contrivance of defending these long soft Nerves from being too much pressed by the anterior Lobes of the Brain under which they lye, is singular, because they have not only the prominent orbital Processes of the frontal Bone, and the *Crista Galli* of the *Ethmoid* Bone to support the Brain on each Side, with the *Falx* by means of the Veins going into the longitudinal Sinus, and other Attachments bearing it up in the Middle, but have a Groove formed in each Lobe of the Brain itself for them to lodge in. Their splitting into so many small Branches before they enter the Bones of the Skull is likewise peculiar to them; for generally the Nerves come from the Brain in disgregated Filaments, and unite into Cords, as they are going out at the Holes of the Bones: But we shall find that this Contrivance is the best for answering the Purpose they are designed for, of being the Organ of smelling; for had they been expanded upon the Membrane of the Nose into a medullary Web, such as the optic Nerve forms, it would have been too sensible to bear the Impressions of such Objects as are applied to it,
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and a Distribution in the more common way of a Cord sending off Branches, would not have been equal enough for such an Organ of Sensation.

The 2d Pair of Nerves are the *OPTIC*, which rise each from the *thalami nervorum optitorum*, and then after making a large Curve outwards, run obliquely inwards and forwards till they unite at the Fore-part of the *Sella Turcica*, and then dividing again, each runs obliquely forwards and outwards to go out at its proper Hole in the sphenoid Bone, accompanied with the proper ocular Artery, to run afterwards to the Globe of the Eye, within which each is extended into a very fine Cup-like Web that lines all the In-side of the Eye as far forwards as the *ciliary Circle*, and is universally known by the Name of *Retina*.

Tho' the Substance of these two Nerves seems to be blended at the Place where they are joined, yet Observations of People whose optic Nerves were not joined at all, and of others who have been blind of one Eye from a Fault in the optic Nerve, or in those who have had one of their Eyes taken out, make it appear that there is no such intimate Union of Substance, the optic Nerve of the affected Side only being wasted, while the other was large and plump; and the same Observations are contradictory to the Doctrine of a Decussation of all the Nerves (§.7.); for the Disease could be traced from the affected Eye to the Origin of the Nerve on the same Side. In many Fishes indeed the Doctrine of Decussation is favoured, for their optic Nerves plain-

ly cross each other without any Union at the Part where they are joined in Men and most Quadrupeds.

Those People, whose optic Nerves were not joined, having neither seen Objects double, nor turned their Eyes different Ways, is also a plain Proof that the Conjunction of the optic Nerves will not serve to account for either the uniform Motions of our Eyes, or our seeing Objects single with two Eyes.

The *Retina* of a recent Eye, without any Preparation, appears a very fine Web, with some Blood-vessels coming from its Center to be distributed on it; but after a good Injection of the Arteries that run in the Substance of this Nerve as is common to other Nerves, it is with Difficulty that we can observe its nervous medullary Substance. As these Vessels are placed in the central Part of the optic Nerve, and there are not medullary Fibres here, where it enters the Ball of the Eye: This may be one Reason why we do not see such Bodies or Parts of Bodies, whose Picture, formed on the Bottom of our Eye, falls on this central Part of the *Retina*. An Inflammation in those Arteries of the *Retina*, which an *Optthalmia* is generally attended with, may very well account for that Tendernefs in the Eyes, and Inability to bear the Light which People have in that Disease. The Over-distension of these Vessels may likewise serve to account for the black Spots observed on bright coloured Bodies especially, and that smoaky Fog, thro' which all Objects are seen by People in some Fevers. If those Vessels lose their Tone and remain preternaturally distended, no

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Objects may affect our *Retina*, tho' the Eye externally appears sound, or this may be one Cause of an *Amaurosis* or *Gutta serena*.

The **THIRD PAIR** rise from the anterior Part of the *Processus annularis*, and piercing the *Dura Mater* a little before and to a Side of the lateral Extremities of the posterior clinoid Process of the sphenoid Bone, run along the *Receptacula*, or *cavernous Sinuses*, at the Side of the *Ephippium*, to get out at the *Foramina lacerata*, to be distributed to the Globe of the Eye, to the *Musculus rectus* of the *Palpebra*, and to the *Attollens*, *Adductor*, *Deprimens* and *obliquus minor* Muscles of the Eye-ball. These Muscles being principal Instruments in the Motions of the Eye-lid and Eye-ball, the Nerve has therefore got the Name of the *Motor Oculi*. I have frequently observed in Convulsions the Eye-lids widely opened, the *Cornea* turned up and outwards, and the Eye-balls sunk in the Orbit; which well described the conjunct Action of the Muscles which this Pair of Nerves serves. Possibly the Distension of a considerable Branch of the Carotid, which passes over this Nerve near its Origin on each Side, may be the Reason of that Heaviness in the Eye-lids and Eyes, after drinking hard or eating much.

The **FOURTH PAIR**, which are the smallest Nerves of any, derive their Origin from the posterior Base of the *Testes*, and then making a long Course on the Side of the annular Protuberance, enter the *Dura Mater* a little farther back and outwards than the third Pair, to run also along the *Receptacula*, to pass out at the *Foramina lacerata*, and to be entirely spent
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on the *Musculi trochleares*, or superior oblique Muscles of the Eyes. The rotatory Motions and the Advancement of the Eye-balls forward, by which Motions several of our Passions are expressed, principally depending on these Muscles, the Nerves that serve them have got the Name of *PATHETICI*.

The *FIFTH PAIR* are large Nerves, rising from the annular Process, where the medullary Processes of the *Cerebellum* join in the Formation of that *Tuber*, to enter the *Dura Mater* near the Point of the petrous Process of the Temporal Bones, and then plunging into the *Receptacula* at the Side of the *Sella Turcica*, each becomes in appearance thicker, and goes out of the Skull in three great Branches.

The first Branch of the 5th is the *OPHTHALMICK*, which runs through the *Foramen lacerum* to the Orbit, having in its Passage thither a Connection with the 6th Pair: it is afterwards distributed to the Ball of the Eye with the 3d, to the Nose, along with the Olfactory, which the Branch of the 5th that passes through the *Orbiter internus* Hole, joins in the Manner already mentioned in the Description of the first Pair. This ophthalmic Branch likewise supplies the *Glandula lacrymalis*, Fat, Membranes, Muscles and the Teguments of the Eye-lids, its longest farthest-extended Branch passing through the *Foramen superciliare* of the *Os Frontis* to be distributed to the Forehead.

The small Fibres which this first Branch of the 5th and the third Pair of Nerves send to the Eye-ball, being situated on the optic Nerve, and after piercing the sclerotick Coat running on the choroid Coat on the Outside of the *Re-*

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tina in their Course to the *Uvea* or *Iris*, may possibly be a Reason, why there is such a Sympathy between the optic Nerve and the *Uvea*, that the *Uvea* contracts to lessen the Pupil, and exclude too numerous Rays of Light; and this, with the Sympathy which must arise from some of the Nerves of the Membrane of the Nostrils being derived from this first Branch of the 5th Pair of Nerves, may also be the Cause, why a strong Irritation of too strong Light upon the *Retina* may produce the same Effect, Sneezing, as when any tickling Substance is applied to the Membrane of the Nose. In the Megrim all the Branches of this Nerve discover themselves to be affected; for the Forehead is racked with Pain, the Eye-ball is pain'd, and feels as if it was squeezed, the Eye-lids shut convulsively, the Tears trickle down, and an uneasy Heat is felt in the Nose. Hence we can understand, where external Medicines will have the best Effect, when applied to remove this Disease, to wit, to the Membrane of the Nose and to the Forehead. Hence we can understand, why alternate Pressure near the superciliary Hole of the frontal Bone sometimes gives immediate Relief in the Megrim.

The second Branch of the 5th Pair of Nerves may be called *MAXILLARIS SUPERIOR*, from its serving principally the Parts of the upper Jaw. It goes out at the round Hole of the sphenoid Bone, and sends immediately one Branch in the Channel on the Top of the *Antrum maxillare*, the Membrane of which and the superior Teeth are supplied by it in its Passage. As it is about to go out at the *Orbiter externus* Hole, it sends a Nerve through

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through the Substance of the *Os maxillare*, to come out at *Steno's Duct*, to be distributed to the anterior Part of the Palate; and what remains of it escaping at the *Orbiter externus* Hole, divides into a great many Branches, that supply the Cheek, upper Lip and Nostril. The next considerable Branch of the superior maxillary Nerve is sent into the Nose by the Hole common to the Palate and sphenoidal Bone, and the remaining Part of this Nerve runs in the *Palato-maxillaris* Canal, giving off Branches to the Temples and Pterygoid Muscles, and comes at last into the Palate to be lost. Hence the Ach in the Teeth of the upper Jaw occasions a gnawing Pain deep seated in the Bones of the Face, with a Swelling in the Eye-lids, Cheek, Nose and upper Lip; and on the other hand, an Inflammation in these Parts is often attended with sharp Pain in the Teeth. Hence an Obstruction in the Duct of the maxillary Sinus, which obliges the Liquor secreted there to find out a preternatural Rout for itself, as I have seen more than once, may be occasioned by the Pain of the Teeth.

The third or *MAXILLARIS INFERIOR* Branch of the fifth Pair going out at the oval Hole of the sphenoid Bone, serves the Muscles of the lower Jaw, and the Muscles situated between the *Os hyoides* and Jaw; all the salivary Glands, the *Amygdalæ* and the external Ear have Branches from it; it has a large Branch lost in the Tongue, and sends another through the Canal in the Substance of the lower Jaw, to serve all the Teeth there, and to come out at the Hole in the anterior Part of the

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the Jaw, to be lost in the Chin and Under-lip: Hence a convulsive Contraction of the Muscles of the lower Jaw, or the Mouth's being involuntarily shut, a great Flow of Spittle or Salivation, a Pain in the Ear especially in Deglutition, and a Swelling all about the Throat, are natural Consequences of a violent Irritation of the Nerves of the lower Teeth in the Tooth-ach; and Pain in the Teeth and Ear is as natural a Consequence of an *Angina*. Hence alternate Pressure on the Chin may sometimes relieve the Violence of a Tooth-ach. Hence destroying the Nerves of a Tooth by actual or potential Cauteries, or pulling a carious Tooth, so often removes immediately all these Symptoms. Hence no Cure is to be found for some Ulcers in the upper or lower Jaw, but by drawing a Tooth.

The *SIXTH PAIR*, which is the smallest except the fourth, rises from the Forepart of the *Corpora pyramidalia*, and entring the *Dura Mater* some way behind the Extremities of the posterior clinoid Processes of the sphenoid Bone, have a long Course below that Membrane, and within the *Receptacula* at the Side of the *Sella Turcica*, to go out at the *Foramina lacerata* into the Orbit, to be lost in the Abductor-muscle of the Eye. In this Passage each of them lies very contiguous to the internal carotid Artery, and to the ophthalmick Branch of the fifth Pair of Nerves. At the same Place where they are contiguous to the Carotid, a Nerve, either, according to the general Description of Anatomists, goes from each of them in an uncommon way (that is the Angle is obtuse beyond where it rises) to descend with the Artery, and
to

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to form the Beginning of the *intercostal* Nerve; or, according to other Authors, this Nerve comes up from the great *Ganglion* of the *Intercostal* to be joined to the sixth here.

The Arguments for this latter Opinion are, That according to the common Opinion, this Beginning of the *intercostal* Nerve, as 'tis called, would rise in a Manner not so ordinary in Nerves. In the next Place it is observed, that the sixth Pair is larger nearer to the Orbit, than it is before it comes to the Place where this Nerve is said to go off; and therefore it is more probable, that it receives an Addition there rather than gives off a Branch. *Lastly*, It is found, that upon cutting the *intercostal* Nerves of living Animals, the Eyes plainly were affected, they lost their bright Water, the Gum, or Gore, as we call it, was separated in greater Quantity, the Pupil was more contracted, the carilaginous Membrane at the internal Canthus came more over the Eye, and the Eye-ball itself was diminished.

To this it is answered in Defence of the more common Doctrine, that other Branches of Nerves go off in a reflected Way as well as this does, supposing it to be the Beginning of the *Intercostal*, and that the Reflection would rather be greater, if it is thought to come up from the *Intercostal* to the sixth. *2dly*, That Nerves enlarge sometimes where there is no Addition made to them, as in the Instance already mentioned of the Trunk of the fifth Pair while below the *Dura Mater*. *3dly*, That the Experiments on living Animals shew indeed, that the Eyes are affected upon cutting the *intercostal* Nerve, but not in the Way might have

have been expected, if the *Intercostal* furnishes such a Share of the Nerve that goes to the *Abductor* Muscle of the Eye; for it might have been thought, that this Muscle would have been so much weakened immediately upon cutting the *Intercostal*, as its Antagonist the *Adductor* would have greatly prevailed over it, and have turned the Eye strongly in towards the Nose, which is not said to be a Consequence of this Experiment. So that the Arguments are still equivocal, and more Observations and Experiments must be made before it can be determined with Certainty, whether the sixth Pair gives or receives a Branch here. In the mean time I shall continue to speak about the Origin of the *Intercostal* with the common Herd of Anatomists.

At this same Place where the *Intercostal* begins, the fifth Pair is contiguous and adherent to the sixth; and it is generally said, that the ophthalmic Branch of the fifth gives a Branch or two to the Beginning of the *Intercostal*, or receives such from it. Others deny any such Communication between them, and those who affirm the Communication confess, that in some Subjects they could not see it. After examining the Nerves here in a great many Subjects, I cannot determine whether or not there are nervous Filaments going from the one to the other. Sometimes I thought I traced them evidently; at other times I observed what I dissected for nervous Filaments, to be no other than collapsed cellular Substance; and in all the Subjects where I had pushed an Injection successfully into the very small Arteries, I could only observe a *Plexus*

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of Vessels connecting the one to the other. In any of these Ways however there is as much Connection, as we are assured from many Experiments and Observations on other Nerves, is sufficient to make a very great Sympathy among the Nerves here. Possibly the Appearances in the Eyes of Dogs, whose intercostal Nerves were cut, might be owing to this Sympathy.

The *SEVENTH PAIR* comes out from the lateral Part of the *annular Process*, behind where the medullary Processes of the *Cerebellum* are joined to that *Tuber*, and, being accompanied with a larger Artery than most other Nerves, enters the *internal Meatus auditorius*, where soon the two great Pacquets of Fibres, of which it appeared to consist within the Skull, separate from each other; one of them enters by several small Holes into the *Vestible*, *Cocklea* and *semicircular Canals*, is stretched on this inner *Camera* of the Ear in a very soft pulpy Substance; and being never seen in the Form of a firm Cord, such as the other Packet of this Nerve and most other Nerves become, is called *PORTIO MOL-LIS* of the auditory Nerve.

The other Part of this seventh Pair passes through *Galen's Foramen cecum* or *Fallopins's Aqueduct* in its crooked Passage by the Side of the *Tympanum*, in which Passage a Nerve sent from the lingual Branch of the inferior maxillary Nerve, along the outside of the *Tuba Eustachiana*, and cross the Cavity of the *Tympanum*, where it has the Name of *Chorda Tympani*, is commonly said to be joined to it. The very acute Angle which this Nerve makes with
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the fifth, or the sudden violent Reflexion it would suffer, on the Supposition of its coming from the fifth to the seventh, whereas supposing its Course from the seventh to the fifth, its Course would be more in the ordinary Way, has made some say, that this *Chorda tympani* should be esteemed a Branch of the seventh Pair going to join the fifth. This same smaller Packet of the seventh gives Branches to the Muscles of the *Malleus* and to the *Dura Mater*, while it passes through the bony crooked Canal, and at last comes out in a firm Cord named *PORTIO DURA*, at the Extremity of this Canal, between the *styloid* and *mastoid* Processes of the temporal Bone, giving immediately Filaments to the little oblique Muscles of the Head, and to those that rise from the styloid Process. It then pierces through the parotid Gland, and divides into a great many Branches, which are dispersed in the Muscles and Teguments that cover all the Side of the superior Part of the Neck, the whole Face and *Cranium*, as far back as the Temples, including a considerable Part of the external Ear. Its Branches having thus a considerable Connection with all the three Branches of the fifth Pair, and with the second cervical, occasions a considerable Sympathy of these Nerves with it. Hence in the Tooth-ach, the Pain is sometimes very little in the affected Tooth, compared to what it is all along the Side of the Head and in the Ear. Hence probably the Relief of the Tooth-ach by Blisters applied behind the Ear, or by a hot Iron touching the *Antihelix* of the Ear. By this Communication or Connexion possibly too it is, that a vibrating String

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held between one's Teeth, gives him a strong Idea of its Sound which no other can hear. Perhaps too the Distribution of this Nerve occasions the Head to be so quickly turned upon the Impression of Sound on our Ears.

The *EIGHTH PAIR* of Nerves rise from the lateral Base of the *Corpora olivaria* in disgregated Fibres, and as they are entering the anterior internal Part of the Hole, common to the *Os Occipitis* and *Temporum*, each is joined by a Nerve which ascends within the *Dura Mater* from the 10th of the Head, the first and second cervical, and sometimes from inferior Nerves: This every Body knows has the Name of the *NERVUS ACCESSORIUS*. When the two get out of the Skull, the *Accessorius* separates from the eighth, and descending obliquely outwards, passes through the *Sternomastoidens* Muscle, to which it gives Branches to be lost in the *Trapezius* and *Rhomboid* Muscles of the *Scapula*. In this Course it is generally more or less joined by the second cervical Nerve.

The large *eighth Pair* soon after its Exit gives Nerves to the Tongue, *Larynx*, *Pharynx* and *Ganglion* of the *Intercostal* Nerve, and being disjoined from the 9th and *Intercostal*, to which it adheres closely some way, runs straight down the Neck behind the internal jugular Vein, and at the interior Side of the internal carotid Artery. As it is about to enter the *Thorax*, a large Nerve goes off from the eighth of each Side: This Branch of the right Side turns round from the anterior to the posterior Part of the subclavian Artery, while the Branch of the left Side turns round the great Curve

Curve of the *Aorta*, both of them mounting up again at the Side of the *OEsophagus*, to which they give Branches, are lost at last in the *Larynx*. These are called the *RECURRENT* Nerves, which we are desired to shun in the Operation of *Bronchotomy*, tho' their deep Situation protects them sufficiently. The Muscles of the *Larynx* being in a good measure supplied with Nerves from the Recurrents, it is to be expected, that the cutting of them will greatly weaken the Voice, tho' it will not be entirely lost, so long as the superior Branches of the eighth Pair are entire.

At or near the Place where the recurrent Nerves go off from the eighth Pair, or frequently from the Recurrents themselves, Nerves go off to the *Pericardium*, and to join with the Branches of the Intercostal that are distributed to the Heart.

After these Branches are sent off, the *Par vagum* on each Side descends behind the great Branch of the *Trachea* and gives numerous Filaments to the Lungs in going to the *OEsophagus*. The one of the left Side running on the Forepart of the *OEsophagus*, communicates by several Branches with the right one in its Descent to be distributed to the Stomach: The right one gets behind the *OEsophagus*, where it splits and rejoins several Times before it arrives at the Stomach, to which it sends Nerves; and then being joined by a Branch from the left Trunk, they run towards the celiac Artery, there to join into the great *semilunar Ganglion* formed by the two Intercostals.

From the Distribution of this *Par vagum*, we may learn how tickling the *Fauces* with a

Feather or any such Substance, excites a Nausea and Inclination to vomit. Why coughing occasions vomiting, or vomiting raises a Cough. Hence we see how the nervous *Asthma* and the *Tussis convulsiva*, Kinkcough, are attended with a straitning of the *Glottis*. How Food ill to digest brings on the *Asthma* on weakly People, and why *Emetics* have frequently cured the *Asthma* very speedily. How the superior Orifice of the Stomach is so sensible as to be looked on as the Seat of the Soul by some. How People subject to Distensions of the Stomach have so often the Sensations of Balls in their Breast or Throats. Why the *Globus hystericus* is so often attended with a violent Strangulation at the *Glottis*. The Sympathy among the Branches of these Nerves will lead us to understand these and several other Phænomena.

The *NINTH PAIR* of Nerves comes from the inferior Part of the *Corpora pyramidalia*, to go out of the Skull at their proper Holes of the occipital Bones. After their Egress they adhere for some way firmly to the 8th and Intercostal, and then sending a Branch that in many Subjects is joined with Branches of the first and second cervical Nerves, to be distributed to the Thyroid Gland and Muscles on the Fore-part of the *Trachea Arteria*, the 9th is lost in the Muscles and Substance of the Tongue. Some have thought this Nerve, and others have esteemed the third Branch of the fifth Pair of Nerves to be the proper gustatory Nerve. I know no Observations or Experiments to prove either Opinion, or to determine that both the Nerves may not serve for Taste.

Tasting, and for the Motion of the Tongue.

The *TENTH PAIR* rises from the Sides of the *Medulla spinalis*, to go out between the *Os Occipitis* and first *Vertebra* of the Neck. After each of them gives a Branch to the great Ganglion of the Intercostal Nerve, they are distributed to the oblique Muscles, and to some of the Extensors of the Head. Whether the Name of the tenth of the Head, or of the first Vertebral, ought to be given to this Nerve, is of no such Consequence as to deserve a Debate.

In the Description of the sixth Pair, I said that I would use the way of speaking which most Anatomists have, to wit, I would say that the Beginning of the Intercostal Nerve comes out of the Skull, and therefore shall here subjoin a cursory Description of this Nerve to those of the Head, notwithstanding its much larger Part is composed of Nerves coming out from the *Medulla spinalis*. There is no greater Incongruity in Point of Method to say, that a Nerve one is describing receives Additions from Nerves that have not been described, than it is to repeat in the Description of a great many Nerves, that each of them gives Branches to form a Nerve which we are ignorant of, which is all the Difference between describing the Intercostal before or after the spinal Nerves.

The Branch reflected from the sixth Pair, joined possibly by some Filaments of the *Ophthalmic* Branch of the fifth, runs along with the internal Carotid thro' the crooked Canal formed for this Artery in the *temporal Bone*, where the little Nerve is very soft and pappy;
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and in several Subjects divides and unites again before it comes out of the Skull. As soon as the Nerve escapes out of this bony Canal it is connected a little way with the eighth and ninth, then separating from them, after seeming to receive additional Nerves from them, it forms a *large Ganglion*, into which Branches from the tenth of the Head, and from the first and second cervical enter. From this Ganglion the Nerves come out again small to run down the Neck along with the carotid Artery, communicating by Branches with the cervical Nerves, and giving Nerves to the Muscles that bend the Head and Neck. As the *Intercostal* is about to enter the *Thorax*, it forms another Ganglion from which Nerves are sent to the Trachea and to the Heart; these designed for the Heart joining with the Branches of the eighth, and passing between the two great Arteries and the Auricles to the Substance of that Muscle. The Intercostal after this being composed of two Branches, one going behind, and the other running over the anterior Part of the Subclavian Artery, forms a new Ganglion where the two Branches unite below that Artery, and then descending along the Sides of the *Vertebrae* of the *Thorax*, receives Branches from each of the dorsal Nerves, which Branches appearing to come out between the Ribs, have given the Name of Intercostal to the whole Nerve. Where the Addition is made to it from the fifth dorsal Nerve, a Branch goes off obliquely forwards, which being joined by other such Branches from the sixth, seventh, eighth and ninth dorsal, an anterior Trunk is formed

ed that passes between the Fibres of the *Appendix musculosa* of the Diaphragm to form along with the other Intercoastal and the Branches of the eighth Pair, a large semilunar Ganglion situated between the cæliac and superior mesenteric Arteries; the Roots of which are, as it were, involved in a sort of nervous Network of this Ganglion, from which a great Number of very small nervous Threads run out to be extended on the Surface of all the Branches of these two Arteries, so as to be easily seen when any of the Arteries are stretched, but not to be dissected off from them; and thus the *Liver, Gall-Bladder, Duodenum, Pancreas, Spleen, Jejunum, Ilium*, and a large Share of the *Colon* have their Nerves sent from this great *solar Ganglion* or *Plexus*.

Several Fibres of this Ganglion running down upon the Aorta, meet with other Nerves sent from the posterior Trunk of the Intercoastal, which continues its Course along the Sides of the *Vertebræ*, they supply the *Glandulæ renales*, Kidneys and *Testes* in Men or *Ovaria* in Women; and then they form a Net-work upon the inferior mesenteric Artery where the Nerves of the two Sides meet, and accompany the Branches of this Artery to the Part of the *Colon* that lies in the left Side of the Belly, and to the *Rectum* as far down as the lower Part of the *Pelvis*.

The Intercoastal continuing down by the Side of the *Vertebræ* of the Loins, is joined by Nerves coming from between these *Vertebræ*, and sends Nerves to the Organs of Generation and others in the *Pelvis*, being
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even joined with those that are sent to the inferior Extremities.

The almost universal Connection and Communication this Nerve has with the other Nerves of the Body, may lead us to understand a great many *Phænomena*, where one otherwise would be greatly surprized at the Sympathy to be observed among the Parts of the Body. One who knows the Course of this Nerve will readily understand why a Stone in the Kidneys, or Ureters, or any other Cause irritating those Organs, should so much more frequently bring on Vomiting and other Disorders of the Stomach, than the Stone or any other stimulating Cause in the Bladder does. The Obstructions of the *Menses* will hence appear capable of occasioning Strangulations, Belching, Colicks, Stomach-aches, and even Convulsions in the Extremities may be owing to such Obstructions, or to any violent Irritations of the Stomach or Guts. With a View to these Communications, I have frequently applied Vesicatories from the Ears to the Clavicles of Children labouring under the *Tussis convulsiva* with observable good Success.

The *spinal* Nerves rise generally by a Number of disgregated Fibres from both the anterior and posterior Part of the *Medulla spinalis*, and soon after form a little Knot or Ganglion where they get on their firm Coats, and are extended into firm Cords. They are distinguished by Numbers, according to the *Vertebrae* from between which they come out, the superior of the two Bones forming the Hole thro' which they pass, being the one from which the Number is applied to each Nerve.

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There are generally said to be *thirty Pair* of them, seven of which come out between the *Vertebrae* of the *Neck*, twelve between those of the *Back*, five from the *Loins*, and six from the *Os sacrum*.

The *FIRST CERVICAL* Pair of Nerves comes out between the first and second *Vertebrae* of the Neck, and having given Branches to join with the tenth Pair of the Head, the second Cervical and Intercostal, and to serve the Muscles that bend the Neck, it sends its largest Branches backwards to the extensor Muscles of the Head and Neck; some of which piercing thro' these Muscles run up on the *Occiput* to be lost in the Teguments there; and many Fibres of it advance so far forward, as to be connected with the *Fibrillae* of the first Branch of the fifth Pair of the Head, and of the *Portio Dura* of the *Auditory Nerve*. Hence possibly it is that a *Clavus hystericus* shall suddenly change from the Fore-head to a violent Pain and Spasm in the Back-part of the Head and Neck.

The *SECOND CERVICAL* is soon joined by some Branches to the ninth of the Head and Intercostal, and to the first and third of the Neck, then has a large Branch that comes out at the exterior Edge of the *Sternomastoideus* Muscle, where it joins with the *Accessorius* of the eighth Pair, and then is distributed to the *Platysma Myoides*, Teguments of the Side of the Neck and Head, parotid Gland and external Ear, being connected to the *Portio Dura* of the Auditory Nerve and to the first cervical. The Remainder of this second Cervical is spent on the *Levator scapulae*, and the Extensors

tensors of the Neck and Head. Generally a large Branch is here sent off to join the *Accessorius* of the eighth Pair, near the superior Angle of the *Scapula*.

To the Irritation of the Branches of this Nerve, it probably is, that in an Inflammation of the parotid Gland, the Neck is pain'd as far down as the Clavicle, the Head is drawn towards the Shoulder of the affected Side, and the Chin is turned to the other Side. In opening the external Jugular-Vein, no Operator can promise not to touch some of the cutaneous Branches of this Nerve with the Edge of the Lancet, which occasions a sharp pricking Pain in the mean Time, and a Numness of the Skin near the Orifice for some Time after.

The *THIRD PAIR* of the Neck passes out between the third and fourth cervical *Vertebrae*, having immediately a Communication with the second, and sending down a Branch, which being joined by a Branch from the fourth cervical forms the *PHRENIC* Nerve. This descending enters the *Thorax* between the subclavian Vein and Artery, and then being received into a Groove formed for it in the *Pericardium*, it has its Course along this *Capsula* of the Heart, till it is lost in the middle Part of the Diaphragm. The right Phrenic has a pretty streight Course, but the left one is obliged to make a considerable Turn outwards, to go over the prominent Part of the *Pericardium* where the Point of the Heart is lodged. Hence in violent Palpitations of the Heart, a pungent acute Pain is felt near the left Orifice of the Stomach.

The other Branches of the third cervical Nerve

Nerve are distributed to the Muscles and Teguments at the inferior Part of the Neck and Top of the Shoulder. No Wonder then that an Inflammation of the Liver or Spleen, an Abscess in the Lungs adhering to the Diaphragm, or any other Cause capable of irritating the Diaphragm, should be attended with a sharp Pain in the Top of the Shoulder, as well as Wounds, Ulcers, &c. of this Muscle itself. If the Irritation of this Muscle is very violent, it may occasion that convulsive Contraction of the Diaphragm which is called a Hiccough, and therefore a Hiccough in an Inflammation of the Liver has been justly declared to be an ill Symptom.

The Irritation of the thoracic Nerves so as to produce sneezing, may sometimes free the phrenic Nerves from any Spasm they occasion; so that sneezing sometimes takes away the Hiccough, and a Derivation of the Fluid of the Nerves any other way may do the same Thing: Or the Hiccough may also be sometimes cured by a Surprise, or any other strong Application of the Mind in thinking or in distinguishing Objects.

The *FOURTH CERVICAL* Nerve, after sending off that Branch which joins with the third to form the Phrenic, and bestowing Twigs on the Muscles and Glands of the Neck runs to the Arm-Pit, where it meets with the *FIFTH, SIXTH* and *SEVENTH* Cervicals and *FIRST DORSAL*, that escape in the Interstices of the *Musculi scaleni*, to come at the Arm-Pit where they join, separate, and re-join in a way scarce to be rightly expressed in Words; and after giving several

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considerable Nerves to the Muscles and Teguments which cover the *Thorax*, they divide into several Branches to be distributed to all the Parts of the superior Extremity. Seven of these Branches I shall describe under particular Names.

1. *CUTANEUS* runs down the Fore-part of the Arm near the Skin to which it gives off Branches, and then divides on the Fore-arm into several Nerves, which supply the Teguments there and on the Palm of the Hand. In opening the Cephalic Vein of the Arm at the ordinary Place, the same Symptoms are produced, as I mentioned to be done in opening the external Jugular-Vein, and by the like Cause, to wit, the hurting a Branch of this cutaneous Nerve with the Lancet.

2. *MUSCULO-CUTANEUS* or *perforans Casserii* passes thro' the *coraco-brachialis* Muscle, and, after supplying the *biceps flexor cubiti* and *brachialis internus*, is spent on the Teguments on the out-side of the Fore-arm and Back of the Hand.

3. *MUSCULARIS* has a spiral Course from the *Axilla* under the *Os humeri*, and backward to the external Part of that Bone, supplying by the Way the extensor Muscles of the Fore-arm, to which it runs between the two *brachii* Muscles, to be chiefly bestowed on the Muscles that extend the Wrist and Fingers; some of its Branches going likewise to the Flexors, and others serving the Skin on the out-side of the Fore-arm, the Extremity of it descends along the *Radius* to the Back of the Hand, in which, and in the back convex Part of

of the Thumb and three large Fingers it terminates.

4. *ULNARIS* is extended along the In-side of the Arm, to give Nerves to the Muscles that extend the Fore-arm and to the Teguments of the Elbow; towards the lower Part of the Arm it slants a little backward to come at the Groove behind the internal Condyle of the *Os humeri*, thro' which it runs to the *Ulna*; in its Course along this Bone it serves the neighbouring Muscles and Teguments; and as it comes near the Wrist, it detaches a Branch obliquely over the *Ulna* to the Back of the Hand, to be lost in the convex Part of several Fingers. The larger Part of the Nerve goes straight forward to the internal Side of the *Os pisiforme* of the Wrist; where it sends off a Branch which sinks under the large Tendons in the Palm, to go cross to the other Side of the Wrist, serving the *musculi lumbricales* and *interossei*, and at last terminating in the short Muscles of the Thumb and Fore-finger. What remains of the ulnar Nerve, after supplying the short Muscles of the Little-finger, divides into three Branches; whereof two are extended along the Sides of the Sheath of the Tendons of the Flexors of the Little-finger, to furnish the concave Side of that Finger; and the third Branch is disposed in the same Way upon the Side of the Ring-finger next to the Little finger.

When we lean or press on the internal Condyle of the *Os humeri*, the Numbness and Prickling we frequently feel point out the Course of this Nerve; I have seen a Weakness and Atrophy in the Parts which it

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mentioned this Nerve to be sent to, after a Wound in the internal inferior Part of the Arm.

5. *RADIALIS* accompanies the humeral Artery to the bending of the Elbow, serving the Flexors of the Cubit in its Way; then, after giving large Nerves to the Muscles on the Fore-part of the Fore-arm, it continues its Course near to the *Radius*, bestowing Branches on the circumjacent Muscles. Near the Wrist it gives off a Nerve which is distributed to the Back of the Hand, and the convex Part of the Thumb, and several of the Fingers. The larger Part of this Nerve passing behind the annular Ligament of the Wrist gives Nerves to the short Muscles of the Thumb, and afterwards sends a Branch along each Side of the Sheath of the Tendons of the Flexors of the Thumb, Fore-finger, Middle-finger, and one Branch to the Side of the Ring-finger next to the Middle, to be lost on the concave Side of those Fingers.

The Manner of these Nerves of the Fingers, both from the *Ulnar* and *Radial* going off, is that a single Branch is sent from the Trunk to the Side of the Thumb and Little-finger farthest from the other Fingers; and all the rest are supplied by a Trunk of a Nerve, which splits into two some way before it comes as far as the End of the *Metacarpus*, to run along the Sides of different Fingers that are nearest to each other.

It might have been observed, that in describing the posterior Branches of the *ulnar* and *radial Nerve*, I did not mention the particular Fingers, to the convex Part of which, they were distri-

distributed. My Reason for this Omission is the Uncertainty of their Distribution ; for tho' sometimes these posterior Branches go to the same Fingers, to the concave Part of which their anterior Branches are sent, yet frequently they are distributed otherwise, and I ought to observe that the muscular Nerve has not always that Termination in the Back of the Hand which I mentioned.

6. *ARTICULARIS* sinks downwards at the *Axilla*, to get below the Neck of the superior Head of the *Os humeri*, and to mount again at the Back-part of it ; so that it almost surrounds the Articulation, and is distributed to the Muscles that draw the Arm back and raise it up.

7. *SCAPULARIS* runs straight to the *Cavitas semilunata* of the upper *Costa* of the *Scapula*, which is made a Hole in the recent Subject, a Ligament being extended from one Angle of the Bone to the other, giving Nerves in its Way to the Muscles of the *Scapula*. When it has passed this Hole it supplies the *Supraspinatus* Muscle, and then descending at the anterior Root of the *Spine* of the *Scapula*, it is lost in the other Muscles that lye on the *Dorsum* of the *Scapula*.

The Situation of these brachial Nerves in the *Axilla*, may let us see how a Weakness and Atrophy may be brought on the Arms by long continued Pressure of Crutches, or such other hard Substances on this Part ; and the Course of them from the Neck to the Arm may teach us how much better Effects, Vesicatories or stimulating nervous Medicines would have, when applied to the Skin, covering the trans-

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verse Processes of the *Vertebræ*, or at the *Axilla*, than when they are put between the Shoulders, or upon the spinal Processes in Convulsions or Palsies of the superior Extremities, where a Stimulus is required.

The *TWELVE DORSAL* Nerves of each Side as soon as they escape from between the *Vertebræ*, send a Branch forward to join the Intercostal, by which a Communication is made among them all, and they soon likewise give Branches backwards to the Muscles that raise the Trunk of the Body, their principal Trunk being extended outwards to come at the Furrow in the lower Edge of each Rib, in which they run toward the anterior Part of the *Thorax*, between the internal and external intercostal Muscles, giving off Branches in their Course to the Muscles and Teguments of the *Thorax*.

The *FIRST* Dorsal has already been said to have this Particular in it, that it contributes to form the brachial Nerves, and that the two Branches of the Intercostal, which come down to the *Thorax*, form a considerable Ganglion with it.

The *SIX* inferior dorsal Nerves give Branches to the Diaphragm and abdominal Muscles.

The *TWELFTH* joins with the first Lumbar, and bestows Nerves on the *Musculus quadratus Lumborum* and *Iliacus internus*.

May not the Communications of all these Nerves be one Reason of the Parts they serve acting so uniformly and conjunctly in Respiration, and conspiring together in the convulsive Motions of Coughing, Sneezing, &c?

The

The twitching Spasms that happen sometimes in different Parts of the Muscles of the *Abdomen*, by any Irritation on the Branches of the lower dorsal Nerves are in Danger of occasioning a Mistake in Practice, by their Resemblance to the Colick, *Nephritis*, &c. The Communications of these lower ones with the Intercostals may serve to explain the violent Effort of the abdominal Muscles in a *Tenesmus* and in Child-bearing.

As the Intercostal is so much larger in the *Thorax* than any where else, and seems to diminish gradually as it ascends and descends, there is some Suspicion that the Trunk of it is here, from which the superior and inferior Parts are sent as Branches.

The *FIVE LUMBAR* Nerves on each Side communicate with the Intercostal and with each other, and give posterior Branches to the Loins.

The *FIRST* communicates with the last dorsal, sends Branches to the abdominal Muscles, to the *Psoas* and *Iliacus*, and to the Teguments and Muscles on the anterior Part of the Thigh; while its principal Branch joins with other Nerves to form the crural Nerve.

The *SECOND LUMBAR* Nerve passes through the *Psoas Muscle*, and is distributed nearly in the same Way as the former, as is also the *THIRD*.

Branches of the *first, second and third* make up one Trunk, which runs along the anterior Part of the *Pelvis*, and passing in the Notch at the anterior Part of the great Hole common to the *Os Pubis* and *Ischium*, is spent on the *Adductor* Muscles and the Teguments on the In-

side

side of the Thigh. This Nerve is called the *OBTURATOR* or *POSTERIOR CRURAL NERVE*.

By united Branches from the *first, second, third* and *fourth* lumbar Nerves, a Nerve is formed that runs along the *Psoas* Muscle, to escape with the external Iliac Vessels out of the *Abdomen*, below the tendinous Arcade of the external oblique Muscle. This Nerve, which is named the *ANTERIOR CRURAL*, is distributed principally to the Muscles and Teguments on the anterior Part of the Thigh. A Branch however of this Nerve runs down the Inside of the Leg to the superior Part of the Foot keeping near to the *Vena saphana*; in opening of which with a Lancet at the Ankle, the Nerve is sometimes hurt, and occasions sharp Pain at the Time of the Operation, and Numbness afterwards.

The Remainder of the fourth Lumbar and the fifth joins in composing the largest Nerve of the Body, which is soon to be described.

Whoever attends to the Course of these lumbar Nerves, and of the spermatic Vessels and Nerves upon the *Psoas* Muscle with the oblique Passage of the *Ureter* over that Muscle, will not be surprized, that when a Stone is passing in this Canal, or even when it is inflamed, the Trunk of the Body cannot be raised erect without great Pain; or that the Skin of the Thigh becomes more insensible, and the Thigh is drawn forward, and that the Testicle often is drawn convulsively towards the Ring of the abdominal Muscles.

The *SIX PAIR* of the *OS SACRUM* consist each of small posterior Branches sent
to

to the Hips, and of large anterior Branches.

The *first*, *second* and *third*, after coming through the three superior Holes of the *Os sacrum*, join together and with the fourth and fifth of the Loins, to form the largest Nerve by much of the Body, which is well known by the Name of *SCIATIC* or *ISCHIATIC* Nerve: This, after sending large Nerves to the different Parts of the *Pelvis*, and to the external Parts of Generation and the *Podex*, as also to the Muscles of the Hips, passes behind the great *Tuber* of the *Os Ischium*, and then over the *Quadrigemini* Muscles to run down near to the Bone of the Thigh at its posterior Part, giving off Nerves to the neighbouring Muscles and Teguments. Some Way above the Ham, where it has the Name of the *Popliteus* Nerve, it sends off a large Branch that passes over the *Fibula*, and sinking in among the Muscles on the anterior external Part of the Leg, runs down to the Foot, to be lost in the superior Part of the larger Toes, supplying the neighbouring Muscles and Teguments every where in its Passage. The larger Branch of the *Sciatic*, after giving Branches to the Muscles and Teguments about the Ham and Knee, and sending a large cutaneous Nerve down the Calf of the Leg, to be lost at last in the exterior Side of the Foot and superior Part of the lesser Toes, sinks below the *Gemellus* Muscle, and distributes Nerves to the Muscles on the Back of the Leg; among which it continues its Course, till passing behind the internal *Malleolus* and in the internal Hollow of the *Os Calcis*, it divides into the two plantar Nerves. The internal of which is distributed to the
Toes

Toes, in the same Manner as the radial Nerve of the Hand serves the concave Side of the Thumb and Fingers, and the external Plantar is divided and distributed to the Sole of the Foot and Toes, nearly as the ulnar Nerve is in the Palm of the Hand and in the concave Part of the Fingers.

By applying what was said of the Nerves in general to the particular Distribution of the Nerves of the inferior Extremities, we may see how People with fractured Legs, especially where there are Splinters, should be so subject to convulsive Startings of the fractured Member, and why upon tying the Blood-vessels in an Amputation of the Leg, the Patients should sometimes complain of violent Pain in their Toes; why such Patients should also be troubled with Startings, or why, for a considerable Time after the Amputation of the diseased Limb, when the Suppuration is well advanced, they should complain of Pain in the Sore which occasioned the Amputation.

The *FOURTH* Nerve of the *Os sacrum*, which with the two following is much smaller than the three superior, soon is lost in the *Vesica urinaria* and *Intestinum rectum*.

The *FIFTH* comes forward between the Extremity of the *Os sacrum* and *Coccygis*, to be distributed principally to the *Levatores Ani*.

The *SIXTH* advances forward below the broad Shoulders of the first Bone of the *Os Coccygis*, and is lost in the *Sphincter Ani* and Teguments covering it.

The Branches of the four last cervical Nerves, and of the first dorsal, which are bestowed on the superior Extremity, and the two Crurals,

Of the particular Nerves. 71

Crurals, with the Sciatic, which are distributed to the inferior Extremities, are much larger proportionally to the Parts they serve, than the Nerves of the Trunk of the Body, and especially of the *Viscera* are; and for a very good Reason, that in the most common necessary Actions of Life a sufficient Quantity of Fluid, on which the Influence of Nerves seems to depend, may be supplied to the Muscles there, which are obliged to perform so frequent and violent Contractions. The Size of the Nerves of the inferior Extremities seems larger proportionally than in the superior Extremities; the inferior Extremities having the Weight of the whole Body to sustain, and that frequently at a great Disadvantage. What the Effect is of the Nerves here being lesed, we see daily, when People happen by sitting wrong to compress the sciatic Nerve, they are incapable for some time after to support themselves on the affected Extremity; and this is still more remarkable in the *Sciatic* or *Hip-Gout*, in which the Member is not only weakned, but gradually shrivels and wastes.

T H E



T H E
Systole and Diastole
 O F T H E
 H E A R T,
 And the Reciprocal Actions of its
 AURICLES and VENTRICLES
 ACCOUNTED FOR.

THAT the Account I am to give of the alternate Motions of the Heart may be rightly understood, it will be necessary to mention the few following Propositions on which it depends.

I. All Muscles are furnished with Blood-vessels and Nerves, and their Action depends on the Influx of Blood, and of the nervous Fluid into their muscular Fibres; therefore whenever Muscles are deprived of a sufficient Quantity of either one or other of these Liquors

quors or of both, their Action is weakened or ceases. The Truth of this has been fully proved by the Experiments of compressing, tying and cutting the Nerves or Arteries of Muscles.

2. All Muscles are in a constant State of Action as long as Blood and nervous Fluid are freely supplied to them. This seems evident from the continued Contraction of the Sphincters of the Bladder and *Anus*, and of Muscles, whose Antagonists are cut asunder or become paralytic.

Tho' in these two Propositions, I have assumed a Fluid of the Nerves, for the Probability of which, see the Arguments in the foregoing Treatise, yet to avoid a Dispute, it may be here remarked, that the following Account of the Heart's Motions, will equally hold good, by supposing the Nerves to be solid Cords acting by Elasticity, Vibration, &c. if it is only granted, that their Action is necessary to the Contraction of Muscles, and that Compression is capable to hinder that Action, which Experiments plainly shew it is.

3. The Nerves of the Heart pass to it between the two Auricles or two Arteries, and between the Auricles and Arteries.

4. The *Coronary* Arteries, which are the only ones that supply the Heart, rise from the *Aorta* immediately above the middle loose Part of the semilunar Valves, in the same Height of the *Aorta* as where the Angles of these Valves are fixed.

5. The Edges of the semilunar Valves are duplicated with a muscular Corpuscle in the Middle, and muscular Cords running oblique-

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ly from that Corpuscle to the Insertion of the Valves into the *Aorta*.

These three last Propositions are evidently made appear to be true by Dissections.

6. Before the Vessels in which the Circulation is performed can act, it is necessary to suppose them full of their Liquors, otherwise the whole Vascular System could not be all at once put into Action, and the Motion of the Fluids sent out from the Heart, could not be propagated to that in the returning Vessels; consequently the Circulation would be stopped almost as soon as begun.

If then both Auricles and Ventricles attempt, upon the first Communication of Motion, to contract; the Ventricles being stronger will force their own Contraction, and hinder the Contraction of the Auricles, which must be in the mean time much dilated by the Influx of Blood from the Veins (Prop. 6.) and at this Time, the Arteries are also distended by the Blood thrown out of the Ventricles; therefore the Cardiac Nerves lying between them, (Prop. 3.) will be compressed and prevented from exerting their Office. While this happens to the Nerves, the Blood rushing out of the left Ventricle into the *Aorta*, and thrusting the semilunar Valves outwards and upwards, distends the great Artery considerably, whereby the Valves are stretched, and their lunated Edges are brought to be straight and as high as their Angles; consequently these Edges, thus raised and pressed to the Sides of the *Aorta*, are made to cover the Orifices of the *Arteriae coronariae*, which the Corpuscles will assist to do more adequately; and there-

therefore, while they are in this Situation, no Blood can be sent to the Substance of the Heart. If then the Nerves do not exert their Office, and Access is denied to the Blood, this Muscle, the Heart must (by Prop. 1.) become paralytic or unactive.

The Auricles, which were attempting all this Time to contract themselves, will now, when the Resistance to them is removed, throw the Blood they contain into the Ventricles; and the Arteries that were violently distended while the Ventricles pushed the Blood into them, will at this same Time when the Ventricles cease to act, constrict themselves; and the *Valvula semilunares* will, by their Elasticity assisted by the muscular Corpuscles and Cords, be depressed inwards. Since then, by the Constriction of the Auricles and Arteries, the Nerves of the Ventricles are freed from the Compression they suffered while the Auricles and Arteries were distended; and since the Blood in the *Aorta* pressed strongly by the contracting Sides of this Artery, and resisted by the Liquors which are to be thrown through all its Branches, is also pushed with great Force on the Orifice of the left Ventricle, thrusts back the semilunar Valves which stop its Entry into that Cavity, and impetuously rushes into the coronary Arteries: Since then, I say, the Nerves of the Heart are again free from Compression, and the Blood is again sent to the Heart by its Arteries, its muscular Fibres must again contract (by Prop. 2.) And thus, as long as these Causes continue to act and cease alternately, their Effects must be exerted in the same

Manner; that is, as long as an Animal lives, the Heart must have an alternate State of Contraction called its *Systole*, and of Relaxation or *Diastole*; and the Auricles and Arteries must be dilated, while the Ventricles are contracting, and the Ventricles must be dilated while the Auricles and Arteries are constricted, or their Actions must always be reciprocal.



T H E



T H E

DESCRIPTION

Of the Human

Lacteal Sac and Duct.

THE *Receptaculum Chyli* of Pecquet, or *Saccus lacteus* of Van Horne, is a membranous somewhat pyriform Bag, two Thirds of an Inch long, one Third of an Inch over in its largest Part when collasped; situated on the first *Vertebra* of the Loins to the Right of the Aorta, a little higher than the right emulgent Artery, behind the right inferior Muscle of the Diaphragm; it is formed by the Union of three Tubes, one from under the Aorta, the second from the Interstice of the Aorta and Cava, the third from under the Emulgents of the right Side. The *Lacteal Sac*, becoming gradually smaller towards its superior Part, is contracted into a slender membranous Pipe, of about a Line Diameter, which

which is generally named, The *THORACIC DUCT*. This passes betwixt the muscular *Appendices* or inferior Muscles of the Diaphragm, on the Right of, and somewhat behind the Aorta; then, being lodged in the cellular Substance behind the *Pleura*, it mounts between this Artery and the *Vena azygos* as far as the fifth *Vertebra* of the Thorax, where it is hid by the *azygos* as this Vein rises forwards to join the descending or superior *Cava*, after which the Duct passes obliquely over to the left Side behind the *OEsophagus*, *Aorta descendens*, and great Curvature of the Aorta until it reaches the left carotid Artery; behind which, and on the left Side of the *OEsophagus* it runs to the Interstice of the first and second *Vertebra* of the Thorax, where it begins to separate from the carotid, stretching farther towards the left internal Jugular Vein by a circular Turn, whose convex Part is uppermost. At the Top of this Arch it splits into two for a Line and a half, the superior Branch receiving into it a large lymphatic Vessel from the cervical Glands. This Lymphatic appears, by blowing Air and injecting Liquors into it, to have no Valves; when the two Branches are again united, the Duct continues its Course towards the internal Jugular Vein, behind which it descends, and immediately at the left Side of the Insertion of this Vein enters the superior posterior Part of the left subclavian Vein, whose internal Membrane duplicated forms a semilunar Valve that is convex externally, and covers two Thirds of the Orifice of the Duct; immediately below this Ori-

fice.

receives a cervical Vein from the *Musculi scaleni* enters the subclavian.

The Coats of the *Sac* and *Duct* are thin transparent Membranes; from the Inside of which, in the *Duct*, small semilunar Valves are produced, most commonly in Pairs; which are so situated, as to allow the Passage of Liquors upwards, but oppose their Return in an opposite Course. The Number of these is generally ten or twelve.

This is the most simple and common Course, Situation and Structure of the *Receptaculum chyli* and *thoracic Duct*; but having had Occasion to observe a Variety in these Parts of different Subjects, I shall set down the most remarkable of them.

The *Sac* is sometimes situated lower down than in the former Description, is not always of the same Dimensions, is not composed of the same Number of *Ducts*, and frequently appears divided into several small Cells, instead of being one simple Cavity.

The Diameter of the *Duct* is various in most Bodies, and is seldom uniform in the same Subject; but frequently sudden Enlargements or *Sacculi* of it are observable. The Divisions which Authors mention of this *Duct* are very uncertain. I have seen it divided, and one Branch climb over the anterior Part of the *Aorta* at the eighth *Vertebra* of the *Thorax*, and at the fifth slip behind that Artery, to join the other Branch which continued in the ordinary Course. The precise *Vertebra*, where it begins to turn to the left Side, is also uncertain. Frequently it does not split at its superior Arch; in which Case a large *Sac* is found
near

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near its Aperture into the subclavian Vein. Generally it has but one Orifice; tho' I have seen two in one Body, and three in another: Nay sometimes it divides into two, under the Curvature of the great Artery; one goes to the right, another to the left subclavian Vein; and I have found this Duct discharging itself entirely into the right subclavian. The lymphatic Vessel which enters its superior Arch is often sent from the *thyroid* Gland.

Whether is not the Situation of the *Receptaculum chyli* so much nearer the muscular *Appendices* of the Diaphragm in Men than Brutes, designed to supply the disadvantageous Course the Chyle must otherwise have in our erect Posture?

Does not the Descent of the Extremity of the Duct to the subclavian Vein, and the opening of the lymphatic into the Top of the Arch, contribute to the ready Admission of the Chyle into that Vein?

F I N I S.

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